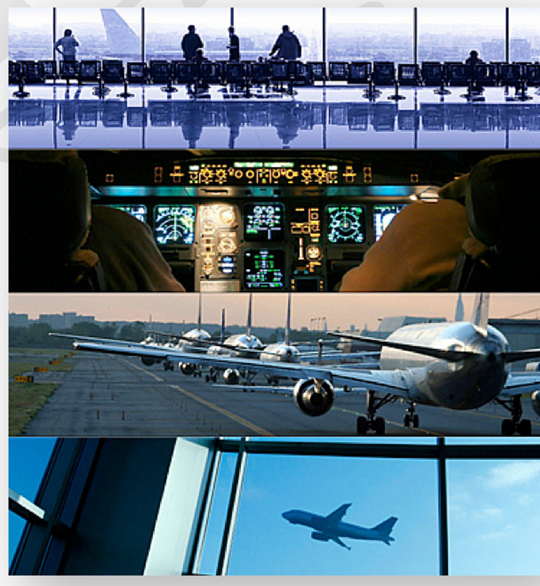
Regional Airport System Planning Analysis

2011 Update



Volume 2: **Major Reports**

- Baseline Aviation Activity Forecasts for Primary Bay Area Airports **August 27, 2009**
- Mid-Point Screening Report **July 26, 2010**
- Baseline Runway Capacity and Delays Report **August 2010**
- Final Scenario Analysis **January 5, 2011**

Prepared for the **Regional Airport Planning Committee**

Metropolitan Transportation Commission

Bay Conservation and Development Commission

Association of Bay Area Governments

Prepared by

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REGIONAL AIRPORT SYSTEM PLAN UPDATE – *BASELINE AVIATION ACTIVITY FORECASTS FOR THE PRIMARY BAY AREA AIRPORTS*

Prepared for:

Regional Airport Planning Committee

Prepared by:

SH&E
an ICF international Company

August 27, 2009

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

The Regional Aviation System Plan (RASP) serves as the San Francisco Bay Area's overall policy document for aviation planning by identifying the region's future airport demand and capacity needs and articulating strategies for accommodating future aviation demand. The goals of this Regional Airport System Planning Update are to:

- Identify and analyze the effectiveness of alternative strategies for accommodating the Bay Area's long-term aviation demand without constructing additional runways at the primary airports;
- Involve stakeholders and the public to aid in building a regional consensus on how to respond to congestion at the primary Bay Area airports; and
- Assist the Regional Airport Planning Committee (RAPC), an advisory committee to the Metropolitan Transportation Commission (MTC), the Association of Bay Area Governments (ABAG) and the Bay Conservation and Development Commission (BCDC), in developing a vision and implementation plan for the region's aviation system.

To accomplish these goals, the current study must address three critical questions:

- What are the capacity limits of the primary Bay Area airports?
- When are these capacity limits likely to be reached?
- What strategies offer the greatest potential to allow the region to efficiently accommodate future aviation demand?

1.2 ROLE OF THE AVIATION FORECASTS

Previous forecasts of Bay Area regional aviation demand were developed in 1999 and adopted for the *2000 Regional Airport System Plan* (2000 RASP). Since that time, there have been significant changes impacting both the airline industry as a whole and the local Bay Area air travel market. A critical first step in this effort is to update the previous forecasts of the region's long-term, aviation demand for its three primary commercial airports – Oakland International (OAK), San Francisco

International (SFO) and Mineta San Jose International Airport (SJC)[1]. The updated forecasts will serve as a primary input to the capacity analysis that will determine when available airport capacity is likely to be reached. The forecasts will also be used to test alternative strategies for accommodating future demand including High Speed Rail (HSR), greater use of regional airports, the deployment of new air traffic control (ATC) technologies, and potential demand management strategies.

There is always uncertainty in forecasting long-term aviation demand, and that uncertainty is exacerbated by current economic conditions. In recognition of this uncertainty, a forecast tracking system will developed to ensure that the expectations of the RAPC and other stakeholders are informed by the latest trends in actual aviation activity levels. The tracking system will allow RAPC to monitor and compare actual airport traffic to the long-term planning forecasts and adjust, as necessary, the expected timeframe in which the region will reach critical capacity thresholds.

1.3 Scope of the Forecast Task

The baseline forecasts for each of the primary Bay Area airports include several aviation activity metrics: airline passengers, passenger aircraft operations, air cargo volumes and all-cargo aircraft operations, and general aviation operations. The aviation activity forecasts have been developed for three growth scenarios—a Base Case, Low Case, and High Case—and for two planning years, 2020 and 2035. The Base forecast will be used for all subsequent analysis, while the Low and High forecasts will be used for sensitivity analysis.

The forecast process included a distinguished working group of experts who oversaw the development of the baseline airport activity forecasts. During three separate sessions the Forecast Working Group provided the technical consultant team with input on the forecast methodologies, assumptions and results. See Appendix A for a list of the Forecast Working Group members.

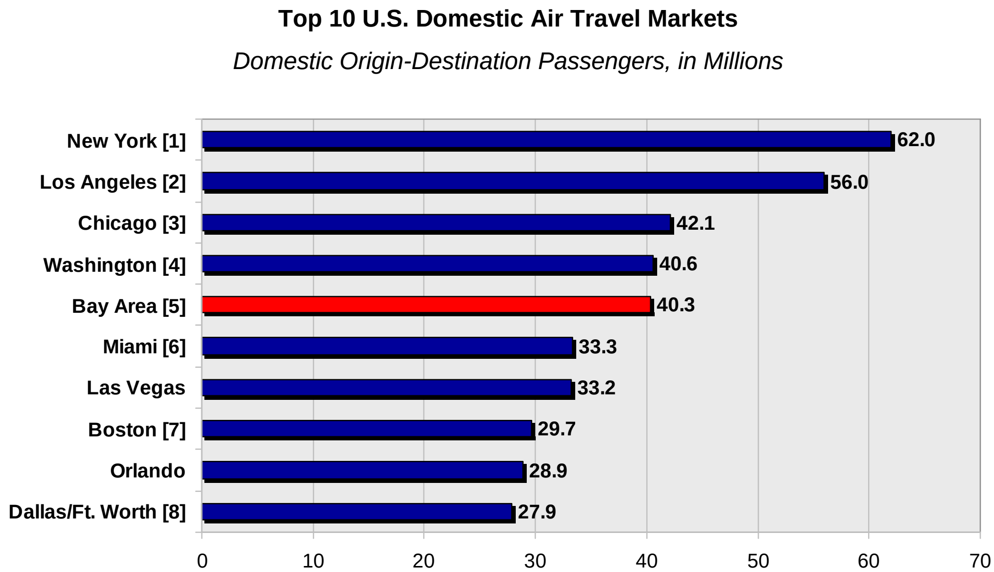
[1] Sonoma County Airport (STS) receives commercial airline passenger services from Horizon Air. In August 2009, Horizon Air provided a total of 5 daily nonstop flights serving Los Angeles, Las Vegas, Portland and Seattle. The airport accommodated 205,000 passengers (enplaned/deplaned) in 2008, representing less than 0.5 percent of total combined Bay Area airport passengers.

1.4 2007 Base Year Aviation Activity at the Bay Area Airports

1.4.1 Airport Passengers

In 2008, the Bay Area was the 8th largest U.S. air travel market, based on enplaned/deplaned passengers (including locally generated origin-destination or "O&D"[2] passengers and connecting passengers). Considering domestic local O&D traffic only, the Bay Area represents the fifth largest U.S. air travel market. (See Exhibit 1-1)

Exhibit 1-1 – The Bay Area is the Fifth Largest U.S. Domestic Passenger Market



Notes:
[1] Includes JFK, LGA and EWR
[2] Includes LAX, ONT, SNA, BUR, and LGB
[3] Includes ORD and MDW
[4] Includes DCA, IAD and BWI
[5] Includes SFO, OAK and SJC
[6] Includes MIA, FLL and PBI
[7] Includes Boston, Providence and Manchester
[8] Includes DFW and DAL

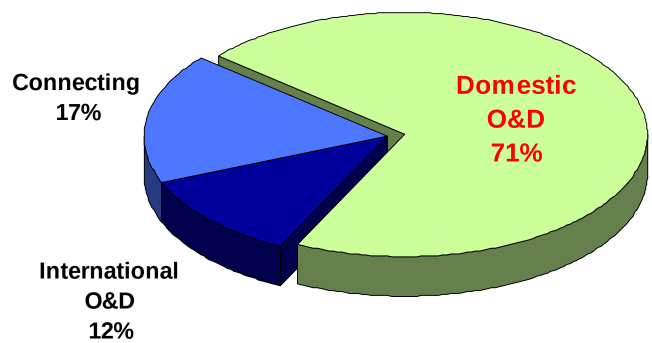
Source: DOT, O&D Passenger Survey, YE 3Q 2007.

[2] Origin-destination (i.e., local) passengers are those for whom the Bay Area airport represents either the origin or final destination of their air trip.

The Bay Area airports accommodated more than 60 million total passengers in 2007. As shown in Exhibit 1-2, domestic O&D passengers represented the largest segment of total Bay Area passengers, accounting for 43.1 million passengers or 71 percent of total airport passengers. International O&D passengers represented 7.1 million or 12 percent, while 17 percent of total passengers at the three Bay Area airports were connecting between other cities.

Exhibit 1-2 – Domestic O&D Passengers Account for More Than 2/3rds of Bay Area Airport Passengers

Mix of Bay Area Airport Passengers



Base Year 2007 Passengers by Airport

In Millions

Airport	Domestic	Intl	Conx	Total
OAK	13.6	0.2	0.8	14.6
SFO	19.5	6.8	9.1	35.3
SJC	10.0	0.2	0.5	10.7
Total	43.1	7.1	10.4	60.6

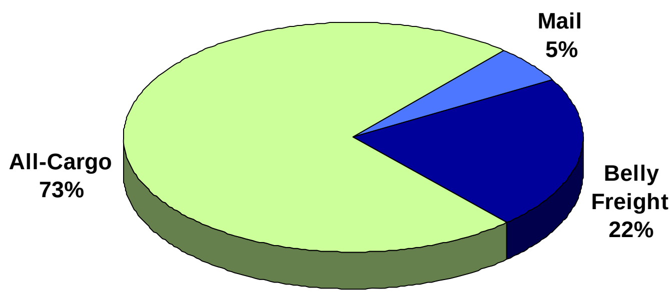
Sources: Airport Data Reports. U.S. DOT, O&D Passenger Survey. U.S. DOT, T100 Database, Database Products Inc.

San Francisco, the largest of the three airports, accounted for 58 percent of total passengers at the Bay Area airports, or 35 million passengers. Oakland, with 14.6 million enplaned/deplaned passengers, accommodated 24 percent of total 2007 Bay Area airport passengers. San Jose, the smallest of the three airports, handled approximately 18 percent, or 10.7 million passengers. The vast majority of the region's international and connecting traffic is concentrated at SFO, which serves as an international gateway and connecting hub for United Airlines.

1.4.2 Cargo Volumes

Air cargo at the Bay Area airports consists of freight[3] and mail, which may be carried in the belly compartments of passenger aircraft or in dedicated all-cargo aircraft. As shown in Exhibit 1-3, 1.4 million tons of air cargo passed through the Bay Area airports in 2007. The majority of Bay Area air cargo was transported in all-cargo aircraft.

Exhibit 1-3 – Dedicated Freighter Aircraft Transport 73% of Bay Area Air Cargo



Base Year 2007 Cargo and Mail by Airport

Enplaned + Deplaned Tons

Airport	Freight		Mail	Total
	Belly	All-Cargo		
OAK	12,163	694,537	7,165	713,866
SFO	294,255	261,198	65,074	620,527
SJC	4,057	85,792	1,577	91,426
Total	310,475	1,041,527	73,816	1,425,818

Source:T100 On-flight Database and Airport Statistical Reports.

The principal integrated cargo carriers[4], FedEx and UPS, primarily operate from Oakland because of its lack of congestion and convenient access to the state highway system and the region's demographic and business centers. FedEx operates a West Coast regional hub at OAK. As a result, OAK accounted for 50 percent of the Bay Area's total 2007 air cargo volume, or 714,000 tons.

[3] Freight includes large heavy shipments as well as express and small package shipments.
[4] In addition to air service, the integrators provide ground pick-up and delivery for complete door-to-door services.

SFO is the dominant Bay Area airport for international air cargo because of its substantial level of international air services operated with widebody aircraft. SFO handled 44 percent of total 2007 Bay Area cargo volume, or 621,000 tons. International cargo shipments accounted for 57 percent of SFO's air cargo volume. SJC handled only 6 percent of the region's total air cargo or 91,000 tons. Most of its air cargo is handled by the integrated carriers, which provide feeder service to their sorting hubs.

1.4.3 General Aviation

General aviation (GA) typically includes all types of aircraft operations other than commercial airline operations. GA encompasses a wide variety of users and aircraft types ranging from pilot training schools utilizing single engine piston (or rotary) aircraft to corporate flight departments and fractional jet operators flying long range, high performance business jets.

The GA operations that will impact airfield capacity at the Bay Area Airports are those using the same runways as the commercial air carriers. At Oakland, only GA jets use the air carrier runway while all other GA operations operate on Oakland's separate North Field. At San Jose, most GA operations use the airport's shorter GA runway. San Francisco's GA activity, predominately corporate jets, operates on the same runways as the commercial air carriers.

Itinerant operations, or flights that arrive from or depart to another airport outside a 20 nautical mile radius, include the aircraft types most likely to use air carrier runways (i.e., business jets and multi-engine turboprop aircraft). Local operations consist primarily of pilot training activity and operate on separate runways at OAK and SJC.

In 2007, there were 155,000 itinerant GA operations at the primary Bay Area airports. Most of these operations (78 percent) occurred at OAK and SJC, which handled approximately 68,000 and 53,000 GA itinerant operations, respectively. At SFO, there were only 34,000 GA itinerant operations.

The mix of itinerant GA operations also varies by airport. Business jets accounted for 81 percent of the operations at SFO compared to 54 percent at SJC and 28 percent at OAK. The high share of business jets at SFO reflects the airport's location relative to downtown San Francisco, airport facilities and the fact that non-jet pilots often tend to avoid busy large hub airports with more complex operating environments.

1.4.4 Total Aircraft Operations and Fleet Mix

In 2007, there were 810,000 itinerant aircraft operations at the three Bay Area airports. (See Exhibit 1-4) These included flights performed by passenger and cargo airlines, air taxi operators, and private aircraft operators. Three-quarters of the combined itinerant aircraft operations at the Bay Area airports were conducted by passenger airlines.

Exhibit 1-4 –Bay Area Airports Handled 810,000 Itinerant Aircraft Operations in 2007

	SFO	OAK	SJC	Total Bay Area
Aircraft Operations				
Commerical Airline - Passenger	326,229	155,856	127,762	609,847
Commercial Airline - All Cargo	9,759	32,174	2,968	44,901
GA Itinerant	34,195	67,538	53,229	154,962
Total	370,183	255,568	183,959	809,710
Percent of Total				
Commerical Airline - Passenger	88.1%	61.0%	69.5%	75.3%
Commercial Airline - All Cargo	2.6%	12.6%	1.6%	5.5%
GA Itinerant	9.2%	26.4%	28.9%	19.1%
Total	100.0%	100.0%	100.0%	100.0%

Note: Excludes military and local general aviation operations.
Source: SH&E analysis of U.S. DOT and FAA databases.

SFO accounted for 46 percent of total aircraft landings and take-offs, making it the busiest of the three Bay Area airports in terms of itinerant aircraft activity. Approximately 91 percent of the aircraft activity at SFO is performed by commercial passenger and cargo airlines. Both OAK and SJC accommodate more itinerant GA operations than SFO and hence the commercial airline shares at these airports are lower at 74 percent and 71 percent, respectively.

As shown in Exhibit 1-5, the airports have distinct commercial airline fleet mixes that reflect their roles within the regional and national air transportation systems. Widebody aircraft have two aisles, are capable of flying very long stage lengths and are predominantly used in long-haul international services, and can generally seat 200 to 600 passengers. Examples of widebody aircraft include the Boeing 747 and the Airbus A-380. Narrowbody aircraft have a single aisle and can generally accommodate from 100 to 250 passengers. Examples of narrowbody aircraft include Boeing 737s and Airbus A-320s. Regional aircraft include regional jets (RJs), which are powered by jet engines, and turboprops (TPs), which are powered by gas turbines and propellers. RJs range in size from 34 to approximately 100 seats. Turboprop operated by commercial airlines generally can accommodate 19 to 70 passengers.

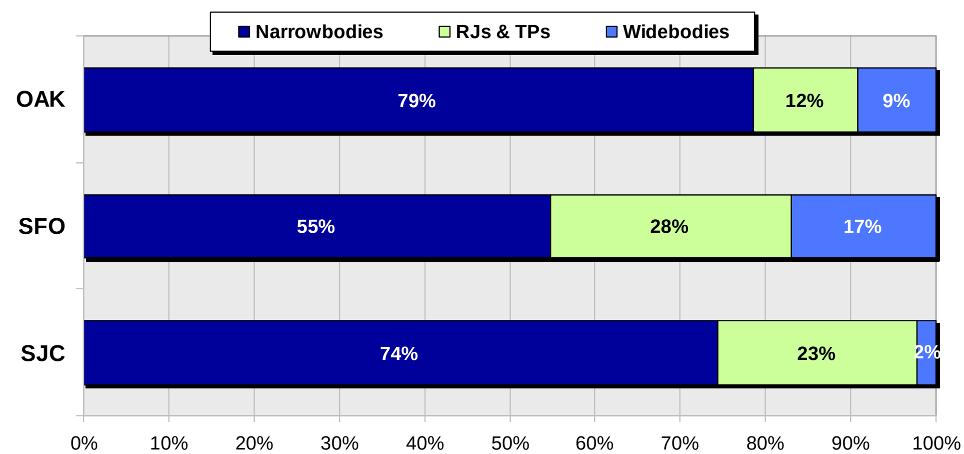
At SFO, 17 percent of commercial airline operations are conducted with widebody aircraft compared to 9 percent at OAK and 2 percent at SJC. The higher widebody share at SFO stems from its role as an international gateway with scheduled widebody aircraft services to Asian and European destinations and the use of widebody aircraft by domestic carriers to link SFO with their respective connecting hub airports. The widebodies that serve OAK are exclusively flown by the integrated cargo carriers.

Exhibit 1-5 – Narrowbodies are the Predominant Aircraft Type Flown by Commercial Airlines Serving the Bay Area Airports – 2007

Commercial Airline Operations by Aircraft Type

Note: Percents may not add due to rounding.

Source: U.S. DOT, T-100 Database.



Among the three airports, SFO has the highest share of commercial airline operations conducted with smaller regional jet and turboprop aircraft. In 2007, these smaller aircraft types accounted for 28 percent of SFO's commercial airline operations and were flown mainly by United Airlines' feeder airlines to funnel connecting traffic to its hub operations. In contrast, regional jets and turboprops accounted for 12 percent of commercial airline operations at OAK and approximately 23 percent of SJC's commercial airline activity.

Narrowbodies, the dominant aircraft type for commercial services at the Bay Area airports, account for approximately three-quarters of all aircraft operations at OAK and SJC. The fleet mixes at these airports are heavily influenced by Southwest Airlines, which exclusively operates narrowbody Boeing 737 aircraft and is the leading carrier at both airports.

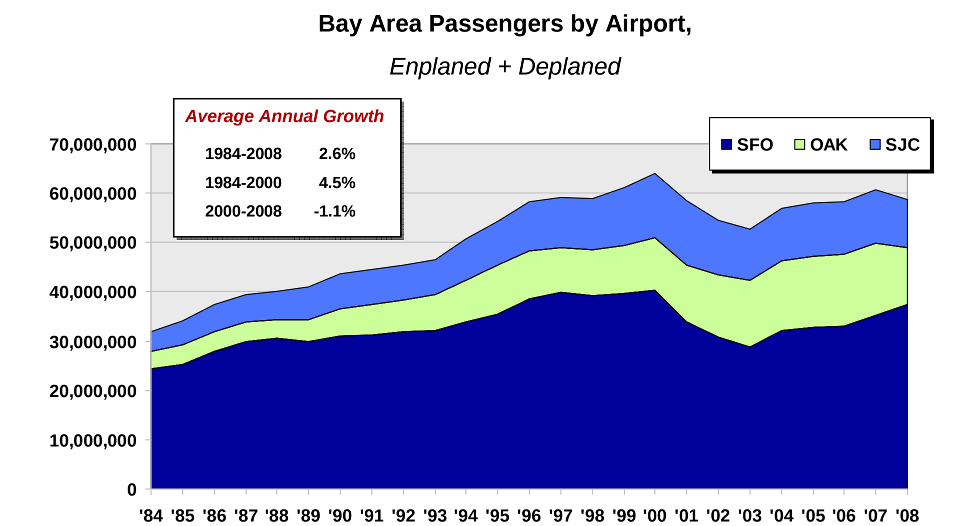
2 AIR PASSENGER DEMAND FORECAST

2.1 HISTORICAL TRENDS

Since the forecasts for the 2000 Regional Airport System Plan were prepared, the airline industry, the local Bay Area air travel market, and the local and global economies have undergone significant changes that have altered the long-term outlook for the region's air travel demand. A national economic recession and terrorist attacks in 2001 sharply reduced national air travel demand in that year. Subsequent changes in airport security procedures had a negative impact on air travel demand in short haul markets by increasing the amount of time required for airport security screenings. The bursting of the dot com bubble in 2000 and 2001 led to significant job losses and decreased compensation in the Bay Area where many internet-based companies were based. More recently, higher fuel prices and the current global economic recession have led to weak airline financial performance, reduced airline capacity and lower air passenger demand. Also, the continued growth of low cost carriers (LCCs), including significant expansion by jetBlue and the entry of Virgin America at SFO, altered the competitive dynamics in the overall airline industry and the Bay Area market in particular.

The impact of these external factors on Bay Area airport passenger demand is shown in Exhibit 2-1. While Bay Area airport passenger traffic increased by 4.5 percent per year between 1984 and 2000, passenger traffic declined between 2000 and 2008.

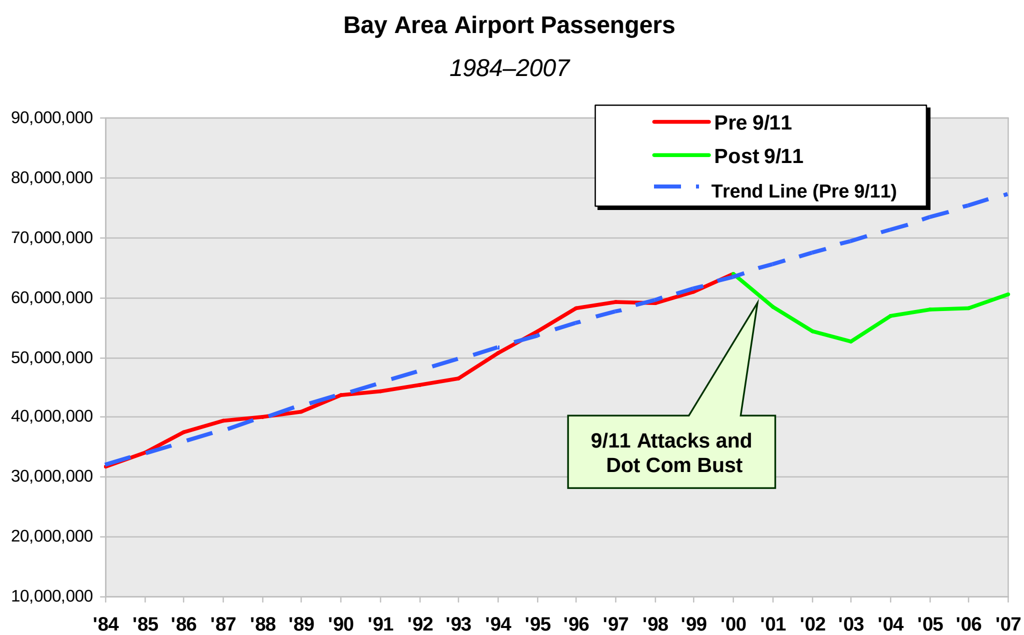
Exhibit 2-1– Passengers at the Primary Bay Area Airports Peaked at 64M in 2000



Sources: Airports Council International, and individual airport statistics.

After more than a decade of stable growth, the Bay Area experienced a sharp drop in airport passenger levels between 2000, when total airport passengers peaked, and 2003. Growth resumed in 2004, but the market has not yet recovered. As shown in Exhibit 2-2, the recent trend line for Bay Area passengers shifted downward indicating a structural change in the Bay Area market.

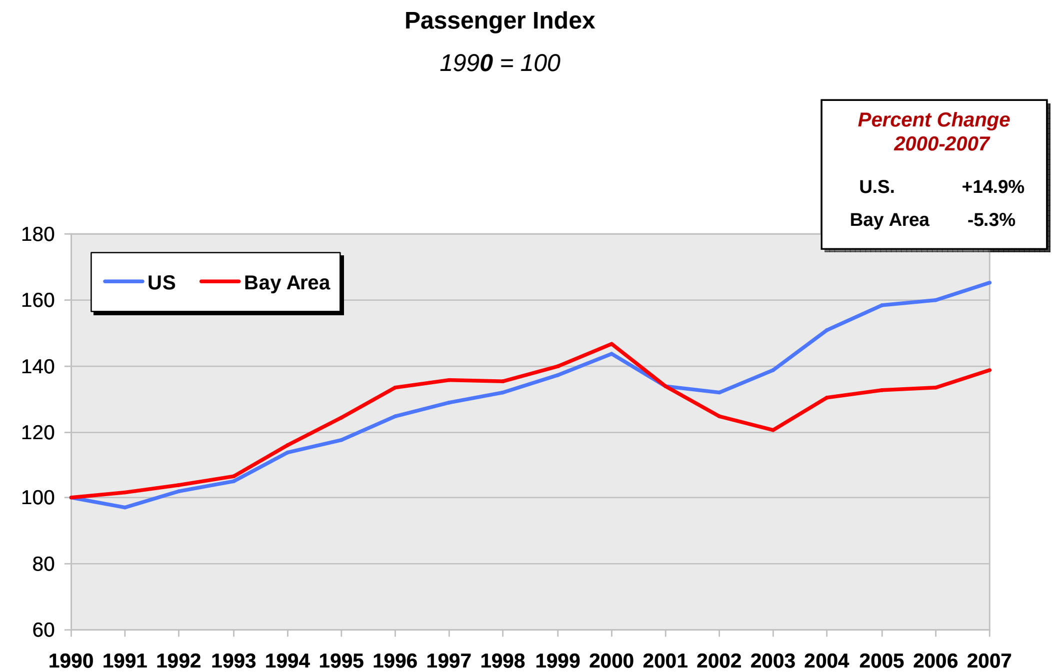
Exhibit 2-2 – Bay Area Airport Passenger Traffic Showed Stable Growth Through 2000



Sources: Airports Council International, and individual airport statistics.

U.S. air travel demand also declined sharply in 2001 and 2002 as a result of the economic recession and the terrorist attacks. However, the overall U.S. market began to recover in 2003 and increased by nearly 15 percent from 2000 to 2007. In contrast, Bay Area passenger demand remains well below its historic peak of 64 million.

Exhibit 2-3– Since 2000, Bay Area Passenger Demand has not Kept Pace with U.S. Air Passenger Demand

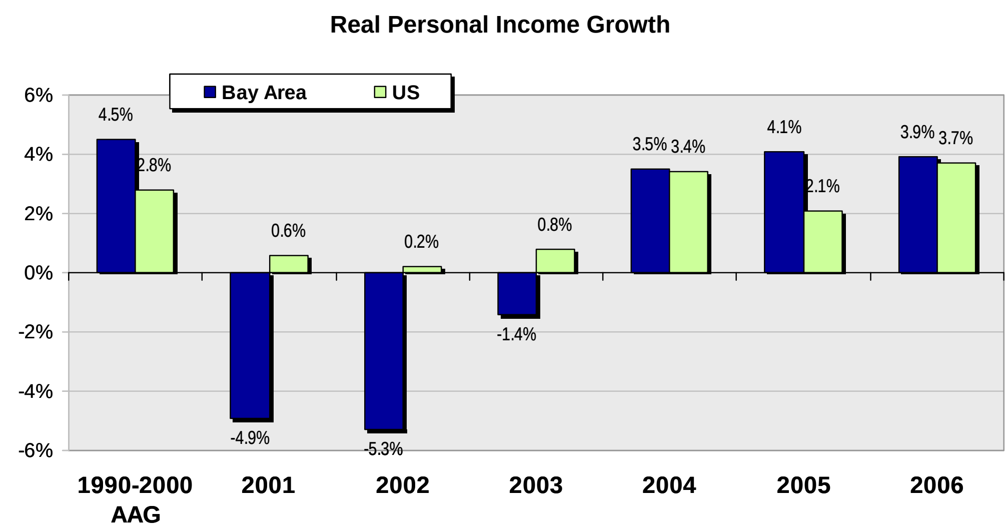


Note: Bay Area includes OAK, SFO and SJC airports.

Sources: Airports Council International, and individual airport statistics.

The Bay Area's comparatively weak performance is chiefly related to the fall-out from the dot com bubble and the negative effect it had on the Bay Area economy. As shown in Exhibit 2-4, Bay Area real personal income fell sharply in 2001 and 2002, and while growth resumed in 2004, it has been only slightly faster than the U.S. as a whole. In contrast, during the 1990s, the Bay Area's real personal income grew significantly faster than the average U.S. rate.

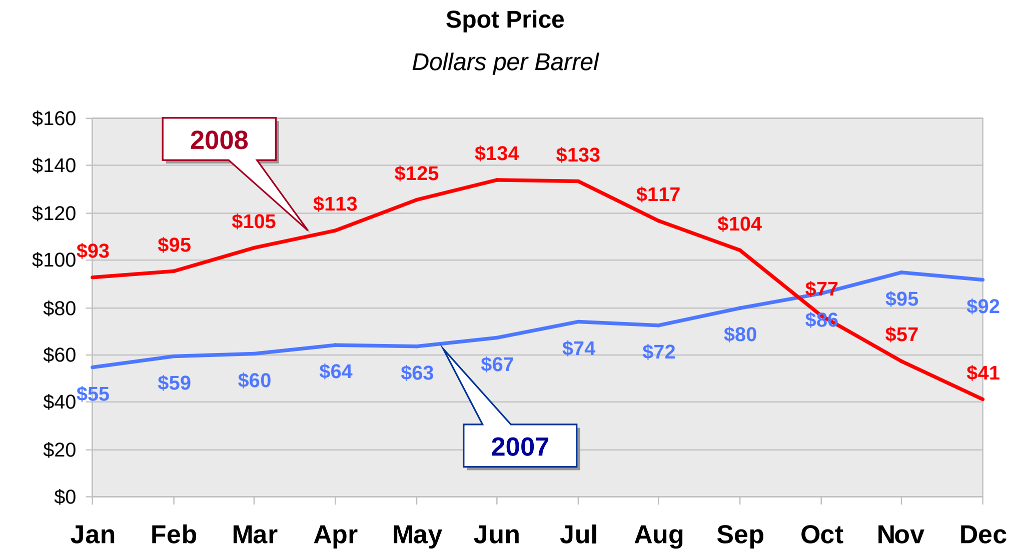
Exhibit 2-4 – The Region Suffered Steep Declines in Personal Income During the Dot Com Fallout



Source: U.S. Department of Commerce, Bureau of Economic Analysis

Last year, the airline industry was buffeted by two external shocks that dampened the demand for air travel. First, the price of oil skyrocketed due to increased global demand, supply constraints and speculation in the oil futures market. The airlines saw their fuel expenses grow from approximately 25 percent of total operating costs in 2007 to 35 percent in 3Q 2008. Airlines responded by parking fuel inefficient airplanes and curtailing scheduled services. As a result of the lower capacity and higher airfares, passenger demand declined throughout the industry.

Exhibit 2-5 – Oil Prices Rose Throughout 2007 and Peaked at Over $130 per Barrel in Summer 2008

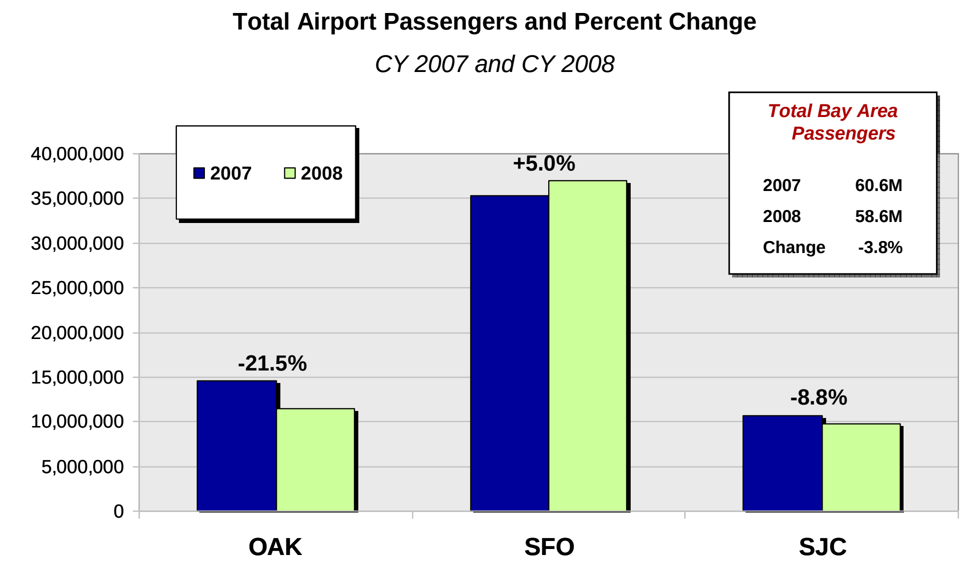


Source: Energy Information Administration

In the second half of 2008, the economic recession that started in late 2007 began to intensify. Falling consumer confidence levels, rising foreclosures in the housing market, a tightening of consumer and business credit, and spiraling unemployment, further weakened air passenger demand. Passengers enplaned by U.S. airlines in 2008 declined by 3.6 percent versus the prior year.

In the Bay Area, total airport passengers fell at a similar rate of 3.8 percent, though the performance of individual airports varied widely. Passenger traffic at OAK fell by 21.5 percent, the steepest drop among the three airports and one of the largest traffic declines among all major U.S. airports. SJC experienced a traffic decline of approximately 9 percent. Conversely, passenger traffic at SFO *increased* by 5 percent. A significant influx of low cost carrier (LCC) services at SFO and the reversal or reduction of its historic fare premiums relative to OAK and SJC were largely responsible for SFO's traffic growth.

Exhibit 2-6 – In 2008, Total Bay Area Passenger Traffic Fell by 3.8%



Note: Enplaned plus deplaned passengers.

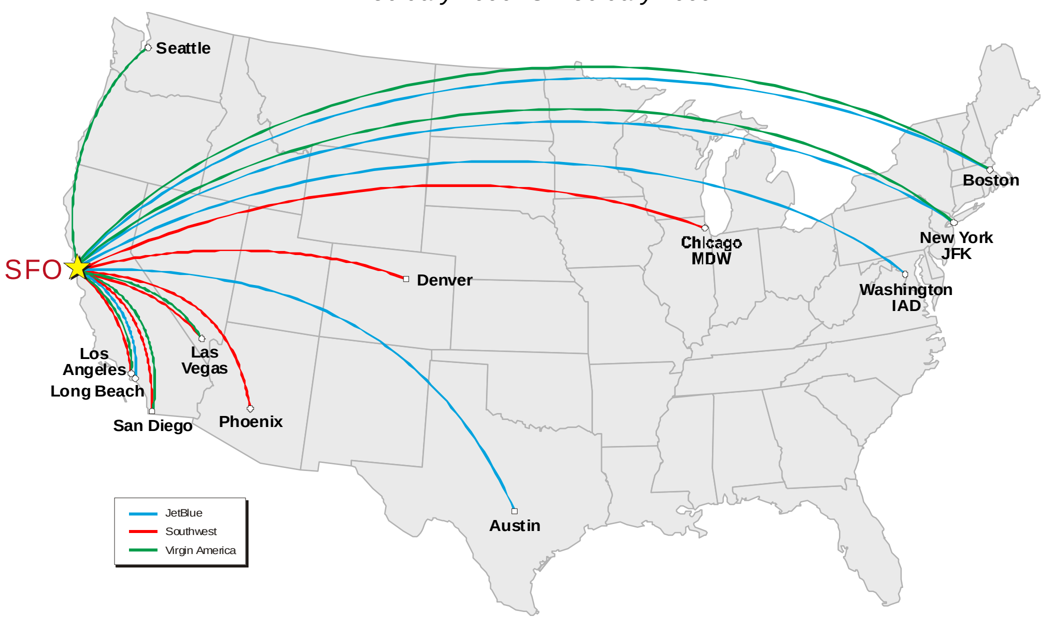
Source: Individual airport statistics.

In large part, the rapid growth in LCC services at SFO was propelled by the formation of Virgin America and its announced plan to make SFO its operating base. Prior to Virgin America's start-up, jetBlue entered the SFO market with nonstop services to New York JFK in May 2007. Virgin America commenced services in August 2007, and Southwest resumed service at SFO in the same month (having exited the market in 2001). Exhibit 2-7 shows the nonstop routes that have been added at SFO by these three low cost carriers as of February 2009.

Exhibit 2-7 – SFO has Gained Several Low Cost Carrier Routes

SFO Low Cost Carrier Nonstop Service Added Since February 2006

February 2006 vs. February 2009



Note: jetBlue SFO-Boston service reinstated May 1, 2009; Virgin America SFO-Orange County service commenced April 30, 2009; and Southwest SFO-Orange County service began May 9, 2009.

Source: OAG

Several carrier bankruptcies contributed to the passenger decline at Oakland. ATA, Aloha and Skybus all ceased operations during 2008. In addition, Southwest and jetBlue reduced Oakland services while adding services at SFO. Finally, American and Continental withdrew entirely from Oakland, and Alaska Airlines sharply reduced its capacity. San Jose also experienced capacity cuts in 2008, but the reductions were not as steep as those at Oakland. Southwest, which accounts for approximately half of domestic scheduled seat capacity at SJC, reduced scheduled daily seats by just 2.2 percent. Overall, from December 2007 to December 2008, domestic capacity at Oakland declined by 27 percent compared to 13 percent at San Jose.

Exhibit 2-8 – Airline Service Reductions at OAK and SJC – December 2008 vs. December 2007

OAK				SJC			
	Daily Seats (Dec)		Percent		Daily Seats (Dec)		Percent
Carrier	2008	2007	Change	Carrier	2008	2007	Change
Southwest	17,125	19,623	-13%	Southwest	10,671	10,911	-2%
Alaska	722	2,044	-65%	American	2,288	2,694	-15%
jetBlue	1,404	1,716	-18%	United	994	1,758	-43%
United *	468	1,244	-62%	Alaska	960	1,318	-27%
ATA	-	1,267	-100%	jetBlue	512	312	64%
Continental	-	477	-100%				
American	-	408	-100%				
Aloha	-	390	-100%				
All Other	1,282	1,680	-24%	All Other	2,730	3,972	-31%
Total Domestic	21,001	28,849	-27%	Total Domestic	18,155	20,965	-13%

* Based on daily scheduled seat departures.

Source: OAG

These service changes caused a redistribution of passenger traffic among the three Bay Area airports. In 2006, before the LCC expansion at SFO, OAK accounted for almost 25 percent of Bay Area airport passengers, compared to 20 percent last year. After years of slowly declining market share, SFO saw its share of the region's passenger traffic increase from 57 percent in 2006 to 64 percent in 2008. For the same period, SJC's share fell only slightly from 18 percent to 17 percent.

2.2 BAY AREA PASSENGER FORECAST APPROACH

Because of the overlapping nature of the markets served by the three Bay Area airports, a regional approach was adopted for forecasting long-term passenger demand. As described in Section 2.8, individual airport forecasts were then developed by distributing the aggregate regional forecasts. The three main segments of airport passenger demand – domestic local, international local and connecting – are driven by different underlying variables, so a separate forecast approach was developed for each segment.

Domestic Local Passengers: A time series regression analysis was used to estimate an econometric equation relating changes in passenger demand to changes in independent explanatory variables. The explanatory variables included measures of underlying economic conditions and the price of airline travel. Independent forecasts and study team assumptions regarding future changes in the explanatory variables were applied to develop the long-term forecast of domestic local passengers.

International Gateway Passengers: A share model that considered Bay Area international passengers by world region as a percent of total U.S. international passengers was used to forecast the region's future international passenger demand. The Bay Area's historic market shares and assumptions regarding future shares were applied to a consensus forecast of U.S. international passenger demand to generate the forecasts of international passengers.

Connecting Passengers: Domestic and international connecting passengers were forecast as a percentage of domestic and international local O&D passengers, respectively, based on the historical relationship of connecting and local passengers in the Bay Area. A key underlying assumption is that SFO continues to function as a connecting hub airport over the forecast horizon.

These forecast methodologies were reviewed by the Forecast Working Group technical experts, who provided input on each of the forecast approaches.

2.3 DOMESTIC LOCAL PASSENGER FORECAST

2.3.1 Forecast Methodology

It is well documented that air passenger demand is highly correlated with economic conditions and the price of air transportation. A forecast model that incorporates these explanatory variables was used to forecast long-term domestic local passenger demand in the Bay Area. An econometric analysis was performed to quantify the relationship between changes in domestic local passenger demand and changes in the economy and the price of air travel between 1990 and 2007.

Three independent variables were found to have the most explanatory power: real personal income for the Bay Area, real average airline yields, and a dummy variable to reflect structural changes since the 9/11 terrorist attacks and dot com bust.

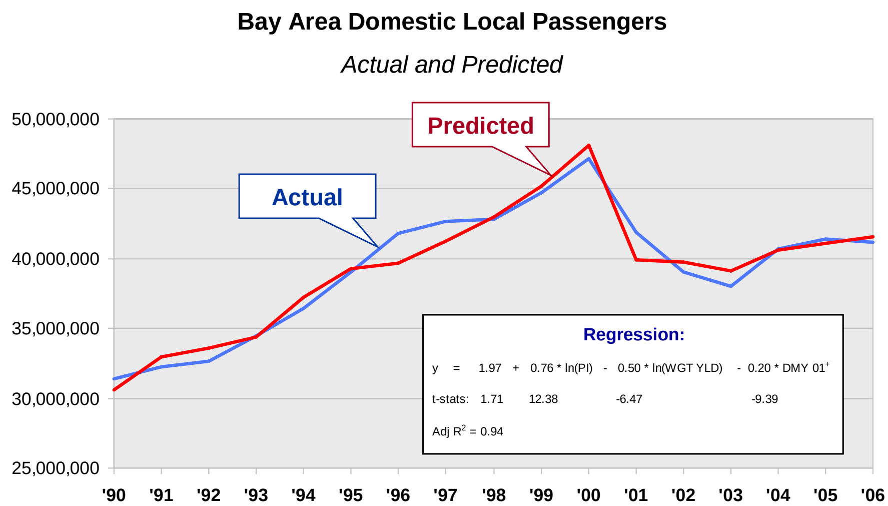
Real Personal Income for the Bay Area: This variable is equivalent to population times inflation-adjusted average per capita income. It is effectively a measure of both the region's population and income levels.

Average Airline Yield: The average yield (i.e., the airlines' average revenue per passenger mile) for the Bay Area's 50 largest domestic O&D markets in 2006 was used to measure the price of airline travel. To avoid distortions in the yield trend over time (due to changes in the mix of destinations and average stage length), the average yield for each year was determined using a constant distribution of passengers by O&D market.

Post 2000 Industry Factors: Finally, a simple dummy variable equal to one for the years 2001 to 2007 and zero for the years 1990 to 2000, was used to quantify the impact of structural changes that have affected the Bay Area air travel market since 2001, but are not easily captured in quantifiable variables. Examples of structural factors include changes in airport security measures (i.e., length of time required for screening and the intrusiveness), higher passenger load factors and increased seating densities. All of these changes have impacted the attractiveness of air travel since 2001, but are difficult to explicitly quantify.

The econometric analysis showed a strong statistical correlation between the Bay Area's domestic local passenger traffic and the selected independent variables. (See Exhibit 2-9) The R^2 value is 94 percent (i.e., the equation explains 94 percent of the variation in passenger traffic for the period examined). Each of the independent variables has the proper sign and a t-stat greater than 2.0, indicating that each variable makes a statistically significant contribution to the prediction of local Bay Area passengers.

Exhibit 2-9 – The Bay Area's Domestic Local Passenger Demand is Highly Correlated with Bay Area Economic Conditions and the Price of Air Travel



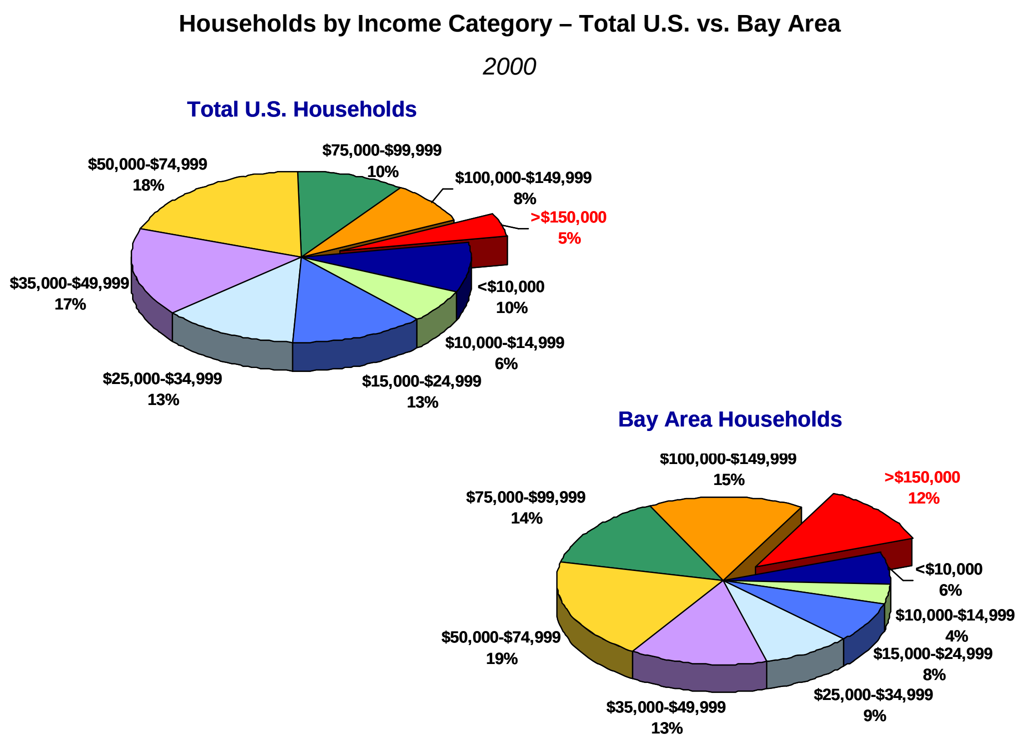
Note: PI – real personal income for the Bay Area
WGT YLD – average market weighted airline yield for the Bay Area
DMY – Post 2000 Industry Factors

The coefficient of 0.76 for real personal income (PI) indicates that a 1 percent change in real personal income results in a 0.76 percent change in local passengers if all other variables are held constant. The 0.76 income elasticity is considered to be low compared to elasticities for other mature air travel markets such as Boston and San Diego, which have shown income elasticities closer to 1.0.

One of the factors that might explain the unusually low measure of income elasticity for the Bay Area is the exceptional growth in air passenger traffic at Sacramento International Airport (SMF) over the historic period. From 1990 to 2007, passenger traffic at SMF grew at an average annual rate of 6.6 percent, or more than three times the Bay Area airports, which grew at 2.0 percent over the same period. The rapid growth at SMF stemmed from Southwest's entry in 1991 and subsequent expansion, and likely resulted in SMF recapturing catchment area passengers that previously had used the Bay Area airports. This factor is likely to have depressed domestic traffic growth at the Bay Area airports and the resulting measurement of income elasticity.

Another factor that may contribute to low income elasticity for the Bay Area is the concentration of income and income growth in the higher income categories. As shown in Exhibit 2-10, more than 26 percent of Bay Area households in 2000 had incomes of $100,000 or more compared to approximately 13 percent for the U.S. as a whole. From 1990 to 2000, the number of Bay Area households with incomes over $150,000 grew by 329 percent whereas the number of U.S. households in the highest income category increased at a slower rate of 235 percent. In the Bay Area, the income growth in the upper brackets may not produce as many trips as income growth in the lower brackets since some of the higher income individuals may not have the ability or desire to make all the trips that their additional income could support.

Exhibit 2-10 – The Bay Area has a Disproportionately High Share of Households in Upper Income Categories Compared to the U.S. Average



Note: Data is based on reported income for 1999.
Bay Area based on San Francisco-Oakland-San Jose, CA CMSA.

Source: U.S. Census Bureau, 2000 Census.

The yield coefficient of -0.50 indicates that a 1 percent increase in average yield results in a 0.5 percent decline in local Bay Area passengers, since demand and the price of air travel are inversely related. This value is within the range of previous estimates for other major U.S. markets. The dummy variable has a coefficient of -0.20, which indicates that local passenger traffic has declined by approximately 18 percent per year from 2001 to 2007 for reasons other than changes in real personal income or airline yields.

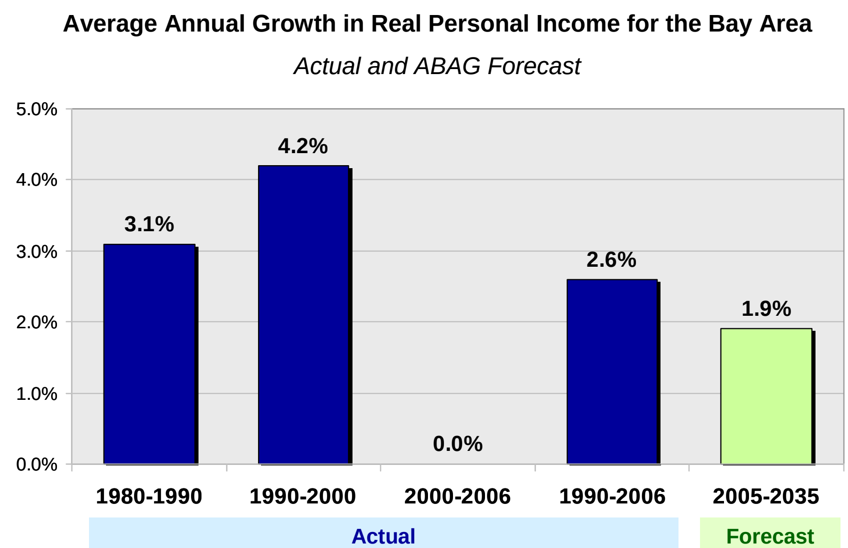
2.3.2 Forecast Assumptions

The forecast equation, assumptions about future elasticities, and forecasts for independent variables were used to predict future domestic local passengers and to create alternative growth scenarios. In addition to a Base (or medium growth) case, Low and High growth cases were also developed to deal with the uncertainty surrounding long-term forecasts and to perform sensitivity analysis.

Personal Income

Real personal income forecasts from ABAG's 2007 Projections were used as the basis for the personal income projections.[5] As shown in Exhibit 2-11, ABAG projected real personal income for the Bay Area to grow at 1.9 percent per year from 2005 to 2035, which is slower than actual growth of 2.6 percent per year over the historic period (1990-2006). Because the forecast growth rate for income is significantly slower than historic income growth, the income growth rate was varied under the different forecast scenarios. The ABAG growth rate for the forecast period, 1.8 percent per[6] year from 2007 to 2035 was used in the Base and Low Cases. The High Case, assumed that the region's personal income would grow at 2.2 percent per year, which is more consistent with the historic growth rate average.

Exhibit 2-11 – Bay Area Personal Income is Forecast to Grow Slowly Over the Forecast Period



Sources: Bureau of Economic Analysis, Bureau of Labor Statistics and ABAG 2007 Projections.

[5] At the time the forecasts were prepared, ABAG's 2009 Projections were not available. The final 2009 Projections will be released in summer 2009.
[6] Reflects one year of actual growth, 2005 to 2006, when real personal income for the Bay Area increased by 4.0 percent according to the U.S. Bureau of Economic Analysis.

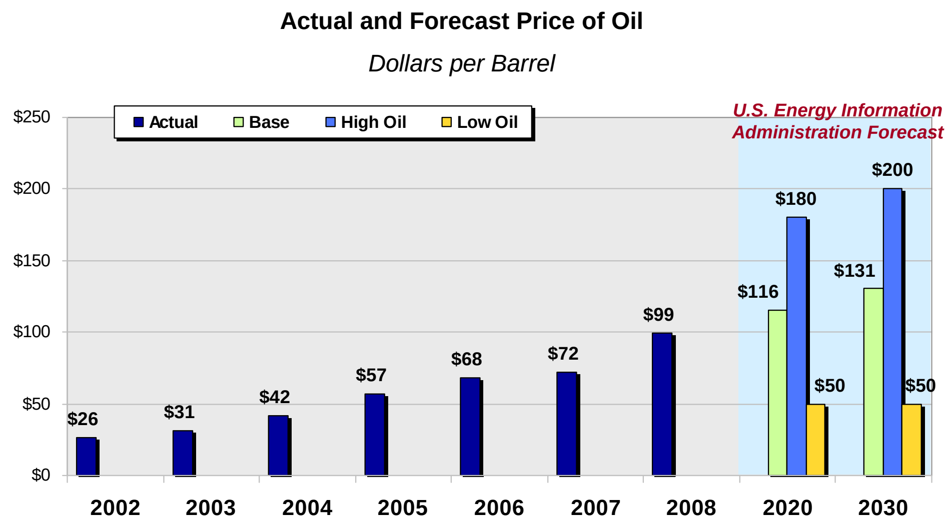
Based on discussions with the Forecast Working Group, which provided input during the forecast task, the personal income elasticity was also varied across the three forecast scenarios. The estimated 0.76 income elasticity was used in the Low Case. An elasticity of 1.00 was assumed in the High Case and an elasticity of 0.88, the midpoint between the Low and High assumptions, was used in the Base Case.

Price of Air Travel

It was assumed that over the forecast period, fuel prices would have the most bearing on future airline yields. Because LCCs have greatly expanded their presence in the U.S. airline industry over the past decade and legacy carriers have greatly reduced their operating expenses through restructuring, going forward the LCCs are unlikely to exert as much downward pressure on airline yields as they have in the past. In the future airfares will be more closely linked to changes in the price of fuel, which now represents a significant portion of overall airline expenses.

Changes in the average Bay Area yield over the forecast period were related to a December 2008 oil price forecast prepared by the federal government's Energy Information Administration (EIA). The EIA projects the 2030 price of oil, in constant 2007 dollars, at $131 per barrel in their Base (or Reference) scenario; $50 in a Low Oil Price scenario; and $200 in a High Oil Price scenario. (See Exhibit 2-12) The impact on Bay Area yields in 2035 was estimated by extrapolating the EIA oil price forecast to 2035 and relating changes in oil prices to changes in overall airline expenses. Based on this analysis, average airline yields for the Bay Area are forecast to grow from 2007 to 2035 at an average annual rate of 0.4 percent in the Base Case (oil projected at $135 per barrel); 1.0 percent in the Low Case (oil projected at $207 per barrel); and -0.3 percent in the High Case (oil projected at $72 per barrel).

Exhibit 2-12 – Changes in Oil Prices Will be a Primary Determinant of Future Air Fares



Note: Forecast prices in constant 2007 dollars.

Source: Energy Information Administration (EIA), Annual Energy Outlook, Early Release, December 17, 2008.

The variable representing Post 2000 Industry Factors was held constant over the forecast period in each of the growth cases, since the structural changes are assumed to persist over the forecast period.

Exhibit 2-13 summarizes the forecast assumptions for each of the growth cases.

Exhibit 2-13 – Forecast Assumptions Were Varied to Produce Base, Low and High Forecasts for Bay Area Domestic Local Passengers

Variable	Base	Low	High
Personal Income (annual change 2007-2035)	1.8%	1.8%	2.2%
Personal Income Elasticity	0.88	0.76	1.00
Price of Oil (2035) [1]	$135	$207	$50
Airline Yields (annual change 2007-2035)	0.4%	1.0%	-0.3%
Post 9/11 Structural Changes [2]	Yes	Yes	Yes

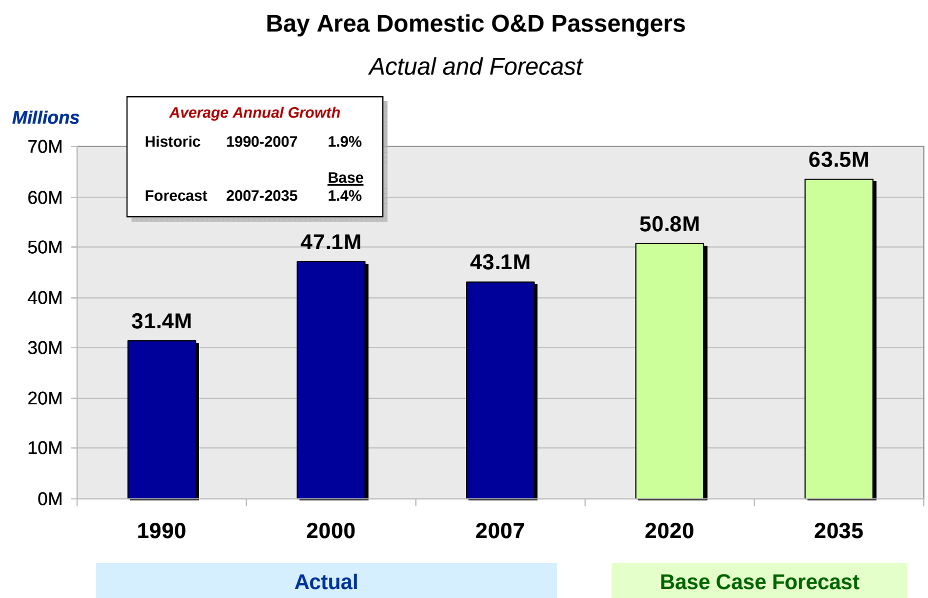
[1] Price per barrel in constant 2007 dollars.

[2] Impact of this variable on passenger traffic is -18.3%.

2.3.3 Domestic Passenger Forecast

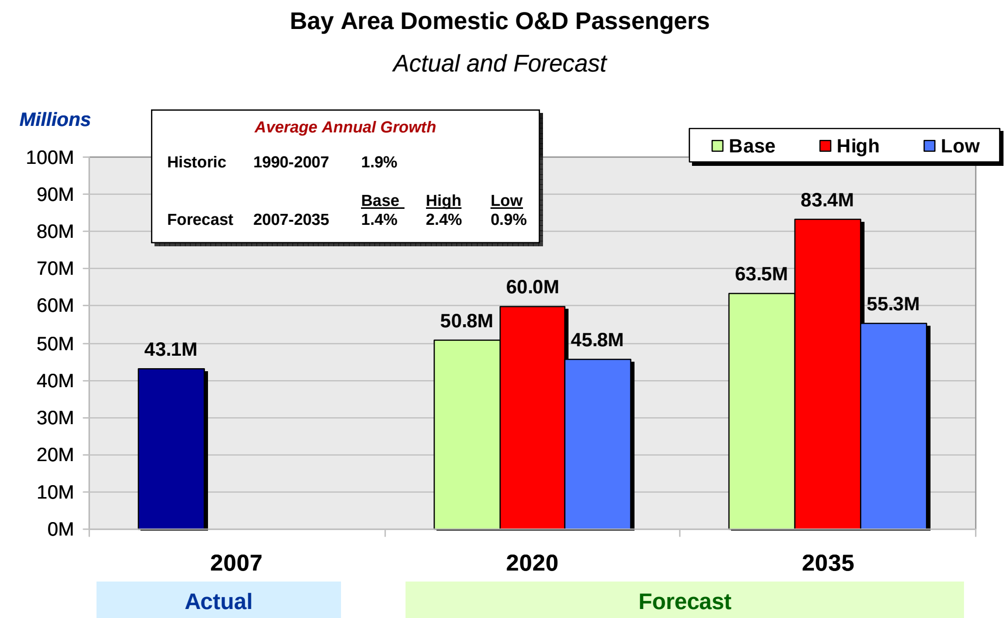
For the Base Case, domestic local passengers for the Bay Area are forecast to grow at 1.4 percent per year, slower than the historic rate of 1.9 percent. As shown in Exhibit 2-14, by 2035, domestic local demand for the Bay Area airports is forecast to reach 64 million passengers.

Exhibit 2-14 – Base Case Domestic Local Passengers are Forecast to Increase by 1.4% per Year



The forecast range for domestic local passengers is 55 million to 83 million passengers. (See Exhibit 2-15) In the Low Case, which assumes slow personal income growth, rising oil prices, and increasing airfares, domestic local passenger traffic is forecast to grow at less than one percent per year. In the High Case, which assumes strong income growth, falling oil prices, and lower airfares, domestic passengers increase at a more robust rate 2.4 percent per year.

Exhibit 2-15 – The Forecast Range for Domestic O&D Passengers is 55M to 83M in 2035



2.4 Domestic O&D Market Forecast

2.4.1 Approach to Domestic O&D Market Forecasts

The forecasts of Bay Area domestic local passengers were used to develop forecasts at the domestic O&D market level, which will be used in the High Speed Rail and Regional Airports alternatives analyses. An O&D market represents a passenger's true airport origin and airport destination regardless of their air flight itinerary, and is an indication of the demand for air travel between two points. For example, a San Jose (SJC)-Boston (BOS) O&D passenger began their air trip at SJC and ended their air trip at BOS. They may have traveled on a non-stop flight or they may have changed planes at an intermediate, connecting point.

Because there is a lot of overlap in domestic air services between the primary Bay Area airports, the domestic O&D market forecasts were developed at the regional level rather than at the individual airport level. Exhibit 2-16, shows the top 25 domestic O&D markets for the Bay Area airports in 2007.

Exhibit 2-16 – The Top 25 Bay Area Domestic O&D Markets Accounted for Nearly 80% of Total Domestic O&D in 2007

Rank	Market	CY 2007 O&D Psgrs	Percent of Total
1	Los Angeles Area *	8,502,247	19.7%
2	New York	2,958,728	6.9%
3	San Diego	2,570,674	6.0%
4	Las Vegas	2,419,655	5.6%
5	Seattle/Tacoma	1,969,274	4.6%
6	Chicago	1,599,462	3.7%
7	Phoenix	1,438,672	3.3%
8	Portland	1,254,448	2.9%
9	Denver	1,238,300	2.9%
10	Washington	1,180,361	2.7%
11	Boston	1,152,274	2.7%
12	Honolulu	931,736	2.2%
13	Dallas/Fort Worth	907,816	2.1%
14	Atlanta	702,062	1.6%
15	Houston	683,916	1.6%
16	Salt Lake City	662,988	1.5%
17	Minneapolis	617,432	1.4%
18	Philadelphia	598,894	1.4%
19	Kahului	458,408	1.1%
20	Austin	449,038	1.0%
21	Detroit	441,699	1.0%
22	Orlando	411,212	1.0%
23	Baltimore	386,446	0.9%
24	Albuquerque	305,411	0.7%
25	Kansas City	295,566	0.7%
	Subtotal	34,136,722	79.2%
	All Other	8,958,963	20.8%
	Total	43,095,685	100.0%

Note: Total O&D Survey passengers for OAK, SFO and SJC, scaled to estimated total local domestic passengers based on reported airport statistics.

* Los Angeles area includes LAX, Burbank, Ontario, Orange County, and Long Beach.

Source: SH&E analysis and U.S. DOT, O&D Survey.

The domestic O&D markets most relevant to the study are those that could be affected by high speed rail (HSR), mainly Los Angeles and other southern and central California markets that would be served by the proposed HSR alignment. Other relevant markets include short/medium distance markets that have high passenger volumes and/or serve as airline connecting hubs that could potentially be served from alternate airports in the Bay Area regions. Examples of these markets include Seattle, Las Vegas, Phoenix and Denver.

The Bay Area's local domestic passengers are heavily concentrated within the top 25 markets, which represent 79 percent of total local passenger demand. Los Angeles is the largest Bay Area O&D market at 8.5 million and it accounted for nearly 20 percent of the Bay Area's domestic local passengers in 2007. The New York market ranks second at 3 million and is followed closely by San Diego, Las Vegas and Seattle at 2 to 2.6 million annual passengers. The intra-California market (principally the Los Angeles area, San Diego, Palm Springs and Santa Barbara) accounted for more than 26 percent of Bay Area domestic O&D passengers in 2007.

The approach to developing a forecast of future Bay Area passengers by O&D market is outlined below.

- Review historic passenger growth by individual O&D market and relationship of the market growth rate to the average growth rate.
- Review the FAA's Terminal Area Forecast (TAF)[7] for overall traffic growth at the destination markets.
- Develop forecast growth rates for individual O&D markets that incorporate historic growth trends and the FAA forecast for destination markets.

Historic growth rates cover the period 1990 to YE 3Q 2008, in order to capture long-term growth trends as well as the impacts of the current economic crisis and the LCC expansion in the Bay Area. The FAA TAF growth rates for destination markets cover the period FY 2007 to FY 2025. The forecast growth rates assume that markets that historically grew faster (or slower) than average would continue to grow faster (or slower). Also, over the forecast period the growth rates for all markets are assumed to move toward the average growth rate for total Bay Area domestic local passengers.

Finally, the forecast growth rates assumed that no market would grow more than two times the average forecast growth rates. Exhibit 2-17 summarizes the historic, FAA TAF and forecast growth rate assumptions for each of the top 25 domestic O&D markets.

[7] The FAA TAF, published annually, is a forecast of long-term passenger and aircraft operations at all active airports in the FAA's National Plan of Integrated Airport System (NPIAS). These forecasts are prepared to meet the budget and planning needs of FAA and provide information for use by state and local authorities, the aviation industry, and the public.

Exhibit 2-17 – Forecast Growth Rate Assumptions for Top 25 Bay Area Domestic O&D Markets

2007 Rank	Market	Historic 1990-FY08	FAA TAF FY07-FY25	Forecast Growth Rate Assumptions (2007 to 2035)		
				Base	Low	High
1	Los Angeles Area *	0.4%	1.9%	0.6%	0.1%	1.8%
2	New York	1.4%	1.1%	1.4%	0.8%	2.6%
3	San Diego	2.1%	2.1%	1.2%	0.6%	2.4%
4	Las Vegas	4.4%	2.0%	1.8%	1.6%	2.2%
5	Seattle/Tacoma	3.8%	2.3%	2.3%	1.7%	3.0%
6	Chicago	1.6%	1.7%	1.5%	0.9%	2.7%
7	Phoenix	0.7%	1.4%	1.2%	0.6%	2.4%
8	Portland	2.6%	2.1%	2.4%	1.9%	3.0%
9	Denver	3.1%	2.6%	2.1%	1.6%	3.0%
10	Washington	2.5%	2.1%	1.5%	0.9%	2.7%
11	Boston	3.2%	1.2%	1.5%	0.9%	2.7%
12	Honolulu	1.2%	1.2%	0.0%	-0.3%	1.2%
13	Dallas/Fort Worth	3.0%	2.2%	1.6%	1.1%	2.8%
14	Atlanta	3.6%	2.7%	2.1%	1.5%	3.0%
15	Houston	2.8%	2.3%	1.7%	1.1%	2.9%
16	Salt Lake City	2.3%	1.7%	2.6%	2.2%	3.0%
17	Minneapolis	2.3%	1.8%	1.8%	1.2%	3.0%
18	Philadelphia	3.0%	2.5%	1.7%	1.2%	2.9%
19	Kahului	3.2%	0.6%	2.3%	1.7%	3.0%
20	Austin	3.5%	1.9%	2.6%	2.4%	3.0%
21	Detroit	1.5%	1.2%	1.2%	0.6%	2.4%
22	Orlando	1.3%	2.2%	1.4%	0.8%	2.6%
23	Baltimore	2.9%	2.5%	2.2%	1.6%	3.0%
24	Albuquerque	2.6%	1.3%	0.7%	0.2%	1.9%
25	Kansas City	2.7%	1.5%	1.0%	0.4%	2.2%

* Los Angeles area includes LAX, Burbank, Ontario, Orange County, and Long Beach.

Notes: All growth rates are average annual rates. Historic growth rate if for Bay Area O&D market and FAA TAF growth rate is for total airport passengers at the destination market.

Source: SH&E analysis; U.S. DOT, O&D Survey; and FAA, Terminal Area Forecasts FY2008 to FY 2025.

The forecast passengers in the Bay Area's top 25 domestic O&D markets (based on 2007 O&D passengers) are shown in Exhibit 2-18. The Los Angeles Area market is forecast at 8.7 to 14.0 million passengers in 2035 depending on the forecast scenario. In the Base Case, the Los Angeles-area markets accounts for approximately 16 percent of total Bay Area domestic O&D passengers compared to nearly 20 percent in 2007. See Appendix B for forecast passengers in the Top 50 Bay Area markets.

Exhibit 2-18 – Forecast 2035 Passengers for Top 25 Bay Area Domestic O&D Markets

2007 Rank	Market	2007 O&D Passengers	Forecast O&D Passengers - 2035 Base	Low	High
1	Los Angeles Area *	8,502,247	10,102,154	8,732,755	14,016,043
2	New York	2,958,728	4,349,120	3,715,681	6,047,628
3	San Diego	2,570,674	3,557,524	3,038,656	4,949,200
4	Las Vegas	2,419,655	3,986,539	3,802,174	4,457,100
5	Seattle/Tacoma	1,969,274	3,724,052	3,184,797	4,542,272
6	Chicago	1,599,462	2,436,467	2,081,893	3,387,069
7	Phoenix	1,438,672	1,998,001	1,706,615	2,779,527
8	Portland	1,254,448	2,460,057	2,104,131	2,893,475
9	Denver	1,238,300	2,238,593	1,914,101	2,856,229
10	Washington	1,180,361	1,782,370	1,522,934	2,477,941
11	Boston	1,152,274	1,745,787	1,491,695	2,427,019
12	Honolulu	931,736	924,251	846,121	1,289,164
13	Dallas/Fort Worth	907,816	1,434,236	1,225,690	1,993,248
14	Atlanta	702,062	1,247,860	1,066,907	1,619,357
15	Houston	683,916	1,101,944	941,788	1,531,209
16	Salt Lake City	662,988	1,367,780	1,207,945	1,529,230
17	Minneapolis	617,432	1,015,802	868,237	1,411,282
18	Philadelphia	598,894	970,287	829,284	1,348,207
19	Kahului	458,408	861,994	737,158	1,057,350
20	Austin	449,038	926,391	883,548	1,035,739
21	Detroit	441,699	614,045	524,496	854,225
22	Orlando	411,212	601,679	514,037	836,690
23	Baltimore	386,446	708,300	605,661	891,366
24	Albuquerque	305,411	374,076	319,362	520,907
25	Kansas City	295,566	386,906	330,403	538,493
	Subtotal	34,136,722	50,916,215	44,196,070	67,289,969
	All Other	8,958,963	12,568,055	11,111,893	16,108,431
	Total	43,095,685	63,484,270	55,307,963	83,398,400

* Los Angeles area includes LAX, Burbank, Ontario, Orange County, and Long Beach.

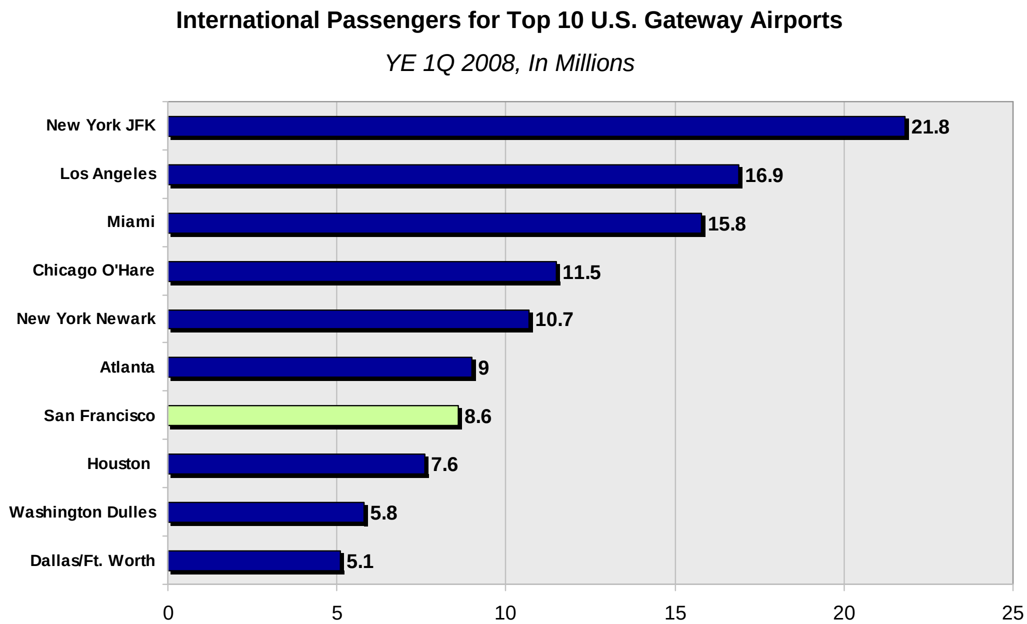
Source: SH&E Analysis.

2.5 International Passenger Forecast

2.5.1 International Forecast Approach

From 1990 to 2007, the Bay Area's international passenger traffic grew by 4.5 percent per year, compared to total domestic traffic (including connecting passengers) which grew by 1.6 percent per year. Faster growth in the international segment is consistent with national trends and SFO's status as a major international gateway airport. (See Exhibit 2-19) The approach used to forecast the Bay Area's long-term international passenger demand reflects SFO's status as a major international gateway and a leading gateway to the Asia/Pacific region while incorporating the impact of the current global economic recession and the longer-term consensus outlook for U.S.-international passenger growth.

Exhibit 2-19 – SFO is the 7th Largest U.S. International Gateway Based on Passenger Traffic



Note: Includes scheduled and charter passengers

Source: U.S. DOT, T100 Database.

Instead of the econometric approach used to forecast domestic O&D passengers a share model that predicts the Bay Area's passenger traffic based on its share of the U.S.-international market was developed to forecast international passenger demand. Because SFO is an international gateway airport with nonstop services to major world regions, it serves passengers connecting from across the U.S. in addition to local Bay Area demand. In 2007, 24 percent of passengers on international flights to and from the bay Area were connecting from other cities. Consequently, passenger levels are determined as much by airline service decisions as local market factors. The major steps in the forecast process are outlined below:

- Examine the Bay Area's historic share of U.S. international passengers by world region and make assumptions about the Bay Area's future market shares.

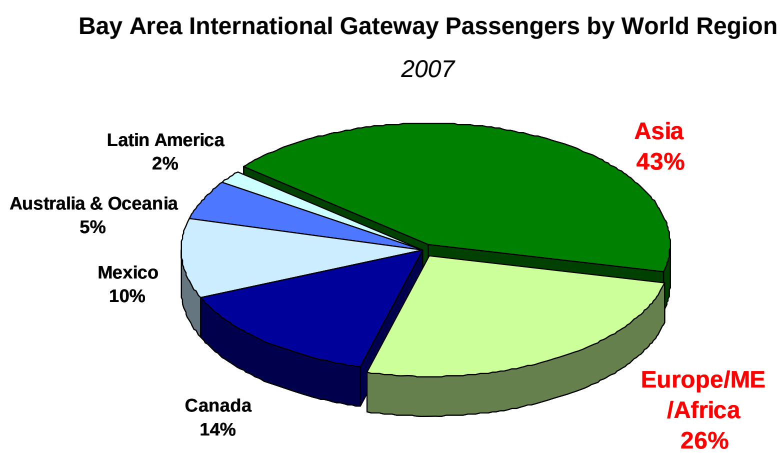
- Review most recent traffic trends, advanced airline schedules and independent industry analysis to develop near-term projections for U.S. international traffic.
- Review the most recent available short and long-term forecasts for U.S. international passenger traffic and develop long-term consensus forecast for the U.S. market.
- Forecast Bay Area international passengers by applying the assumptions about the Bay Area's market shares to the forecast of U.S. international passengers.

2.5.2 Key Forecast Assumptions

Bay Area Gateway Shares

Asia and Europe are the two largest market areas for Bay Area international passengers, accounting for more than two-thirds of total passengers. (Exhibit 2-20)

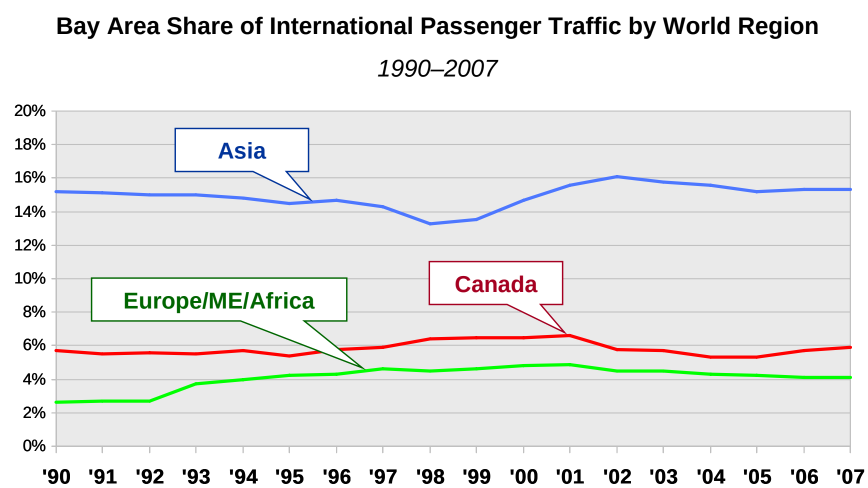
Exhibit 2-20 – Asia and Europe Account for More than Two-Thirds of Bay Area International Passengers



Source: U.S. DOT, T100 Database.

These markets, along with the Canadian market, are mature markets for the Bay Area. As shown in Exhibit 2-21, the Bay Area's share of total U.S. travel to these market areas has remained fairly stable over time.

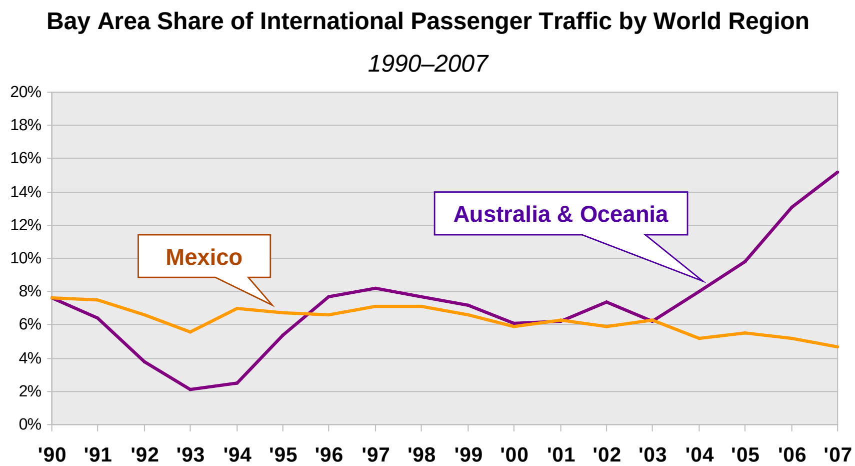
Exhibit 2-21 – The Bay Area's Market Shares for the Asia, Europe and Canada Markets Have Been Fairly Stable



Source: U.S. DOT, T100 Database.

In contrast, the Bay Area's share of the U.S.-Australia/Oceania market, which is less mature than the Pacific and Europe markets, has increased from approximately 6 percent in 2003 to 15 percent in 2007 as new services were added at SFO. (See Exhibit 2-22) The Bay Area's share of the Mexico market has shown some recent declines falling from approximately 6 percent in 2000 to 5 percent in 2007. During this period there has been considerable fluctuation in the Bay Area's scheduled services to Mexico.

Exhibit 2-22 – Bay Area's Share of Australia/Oceania Passengers has Been Growing and Its Share of Mexico has Been Declining



Source: U.S. DOT, T100 Database.

The assumptions regarding the Bay Area's future shares of U.S.-international passenger traffic are summarized in Exhibit 2-23. Over the forecast period, it was assumed that the Bay Area will maintain its market share in the mature markets – Europe, Asia, and Canada. Since SFO is expected to gain new services to Australia as the U.S. –Australia market continues to develop, the Bay Area's share of the U.S.-Australia market was assumed to increase in both the Base Case and the High Case., but was held constant in the Low Case. The Bay Area share assumptions for Mexico were varied by scenario with the share held constant in the Base Case, increased in the High Case and lowered in the Low Case. The Latin America market share was also held constant over the forecast period, based on the historic trend which was very consistent.

Exhibit 2-23 – Bay Area International Market Share Forecast Assumptions

Period	Europe/ME/ Africa	Asia	Canada	Mexico	Australia/ Oceania	Latin America (ex Mexico)
Actual 2007	4.1%	15.3%	5.9%	4.7%	15.2%	0.4%
<u>**Forecast**</u>						
Base 2020	4.1%	15.3%	5.9%	4.7%	16.3%	0.4%
Base 2035	4.1%	15.3%	5.9%	4.7%	17.5%	0.4%
Low 2020	4.1%	15.3%	5.9%	4.4%	15.2%	0.4%
Low 2035	4.1%	15.3%	5.9%	4.0%	15.2%	0.4%
High 2020	4.1%	15.3%	5.9%	5.3%	17.4%	0.4%
High 2035	4.1%	15.3%	5.9%	5.9%	20.0%	0.4%

Forecast U.S.-International Passengers

Independent forecasts of U.S.-International passenger traffic were reviewed to develop a long-term consensus forecast for the U.S. market. The forecasts reviewed were:

1. IATA, *World Passenger Forecast*, October 2008 (passenger forecasts by world region for 2008 to 2012)
2. Boeing, *Current Market Outlook*, July 2008 (forecast revenue passenger kilometers by world region for 2027)
3. FAA, Aerospace Forecasts, March 2008, (passenger forecasts by world region for FY2008 to FY2025)

Since these forecasts were prepared before the worsening of the global economic crisis in the fall of 2008, more recent traffic statistics, advanced airline schedules and independent industry analysis were also reviewed and incorporated into the forecast of long-term U.S. international traffic. The forecast growth rate assumptions are summarized in Exhibit 2-24.

Exhibit 2-24 – Forecast Average Annual Growth Rates by World Region for US-International Air Passengers

Year	Australia & Oceania	Canada	Latin America (ex Mexico)	Europe/ME/ Africa	Asia	Mexico	Total
Actual AAG							
1990-2000	3.7%	3.3%	6.1%	6.4%	5.7%	5.9%	5.7%
2000-2007	0.3%	2.9%	2.9%	0.9%	0.6%	3.1%	1.8%
1990-2007	2.3%	3.1%	4.8%	4.1%	3.6%	4.7%	4.0%
Forecast AAG							
Base Case							
2007-2011	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2011-2012	1.7%	2.9%	4.1%	3.8%	5.0%	4.3%	3.9%
2012-2020	7.1%	2.8%	4.2%	4.6%	5.0%	2.8%	4.2%
2020-2035	5.4%	2.1%	3.2%	3.4%	3.8%	2.1%	3.2%
Low Case							
2007-2011	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2011-2012	1.2%	2.4%	3.6%	3.3%	4.5%	3.8%	3.4%
2012-2020	6.6%	2.3%	3.7%	4.1%	4.5%	2.3%	3.7%
2020-2035	4.9%	1.6%	2.7%	2.9%	3.3%	1.6%	2.7%
High Case							
2007-2011	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2011-2012	2.2%	3.4%	4.6%	4.3%	5.5%	4.8%	4.4%
2012-2020	7.6%	3.3%	4.7%	5.1%	5.5%	3.3%	4.7%
2020-2035	5.9%	2.6%	3.7%	3.9%	4.3%	2.6%	3.7%

To reflect recent cuts in international air services and the impact of the protracted global economic recession, no growth was assumed for the period 2007 to 2011. This assumption for the near-term was applied in all three growth cases.

For the Base Case, IATA's average growth rate for the period 2007-2012 was used to forecast U.S. international passengers for 2012. The lower of the Boeing or FAA long-term growth rates by region were used to project Base Case 2020 U.S. international passengers. Growth for 2020-2035 was assumed at 75 percent of the 2012-2020 growth rate for base Case U.S. international passengers.

The long-term Base Case growth rates were varied to produce forecasts for the Low and High cases. For the Low Case, the 2012-2035 growth rates were assumed to equal the Base Case growth rate less 0.5 percentage points. Similarly, the High Case growth rates for 2012-2035 were assumed to equal the Base Case growth rates plus 0.5 percentage points.

Exhibit 2-25 summarizes the forecast of U.S. international passengers by world region. The forecast growth rates vary from 2.6 percent in the Low Case to 3.5 percent in the High Case. Australia/Oceania is the fastest growing region in all three cases, but over the forecast period it remains the smallest in terms of passenger volume.

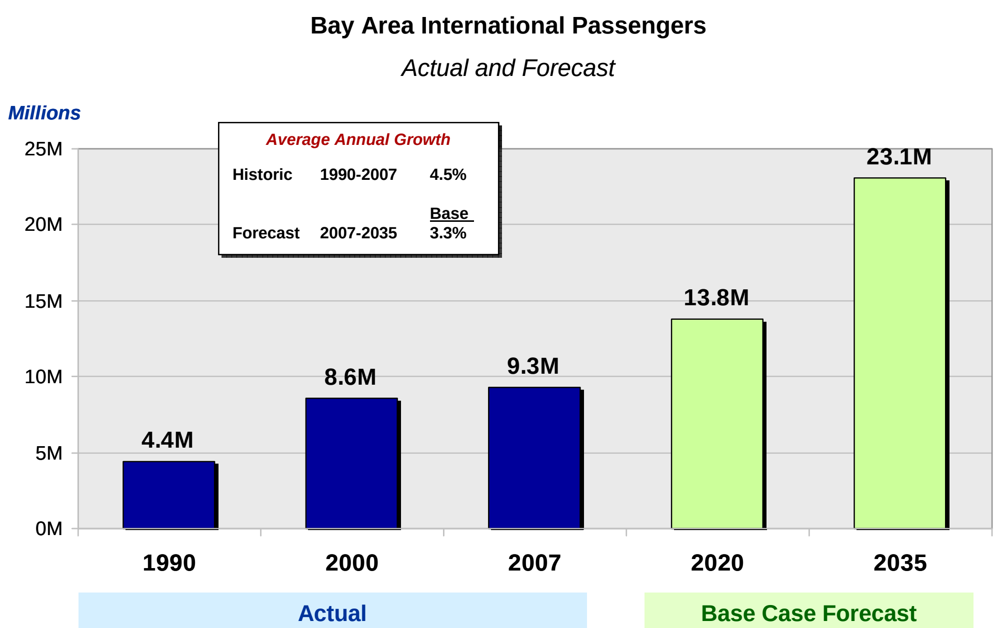
Exhibit 2-25 – Forecast U.S. International Passenger by World Region *(in millions)*

Year	Australia & Oceania	Canada	Latin America (ex Mexico)	Europe/ME/ Africa	Asia	Mexico	Total
Actual							
2007	3.1	21.5	34.2	56.1	24.6	20.0	159.4
Forecast							
Base Case							
2020	5.5	27.5	49.6	83.2	38.2	25.9	230.0
2035	12.0	37.4	79.4	138.0	66.6	35.2	368.7
AAG 2007-2035	4.9%	2.0%	3.1%	3.3%	3.6%	2.0%	3.0%
Low Case							
2020	5.3	26.3	47.5	79.7	36.6	24.8	220.2
2035	10.8	33.3	70.7	122.9	59.4	31.3	328.3
AAG 2007-2035	4.5%	1.6%	2.6%	2.8%	3.2%	1.6%	2.6%
High Case							
2020	5.7	28.8	51.8	86.9	39.9	27.1	240.1
2035	13.5	42.0	89.1	154.9	74.7	39.6	413.8
AAG 2007-2035	5.4%	2.4%	3.5%	3.7%	4.1%	2.5%	3.5%

2.5.3 International Passenger Forecast

In the Base Case, the Bay Area's international passenger demand (including connecting passengers) is forecast to increase at an average annual rate of 3.3 percent from 2007 to 2035. (See Exhibit 2-26) By 2035, the number of Bay Area international passengers is forecast to increase to 23.1 million compared to 9.3 million in the base year.

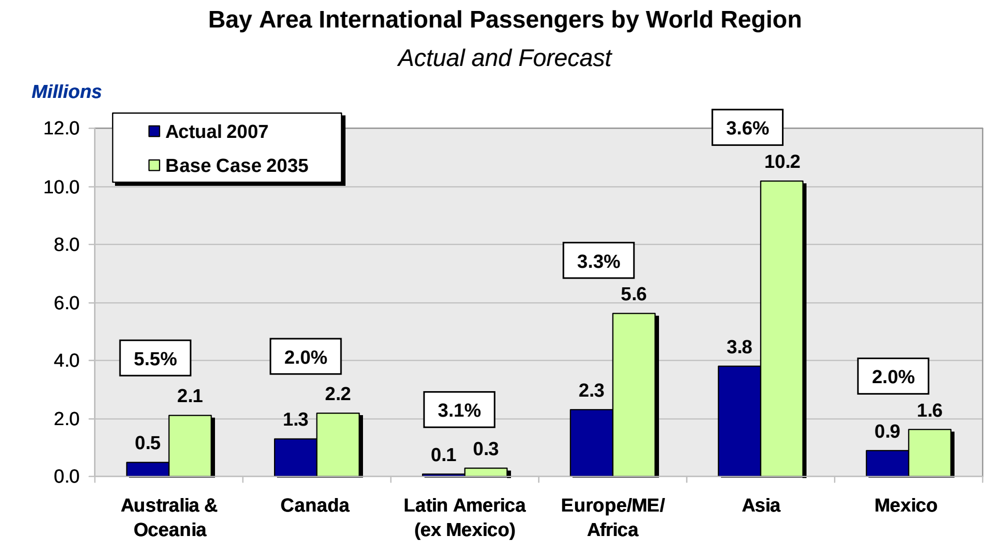
Exhibit 2-26 – Base Case Bay Area International Passengers are Forecast to Grow by 3.3%



Note: Includes local and connecting passengers.

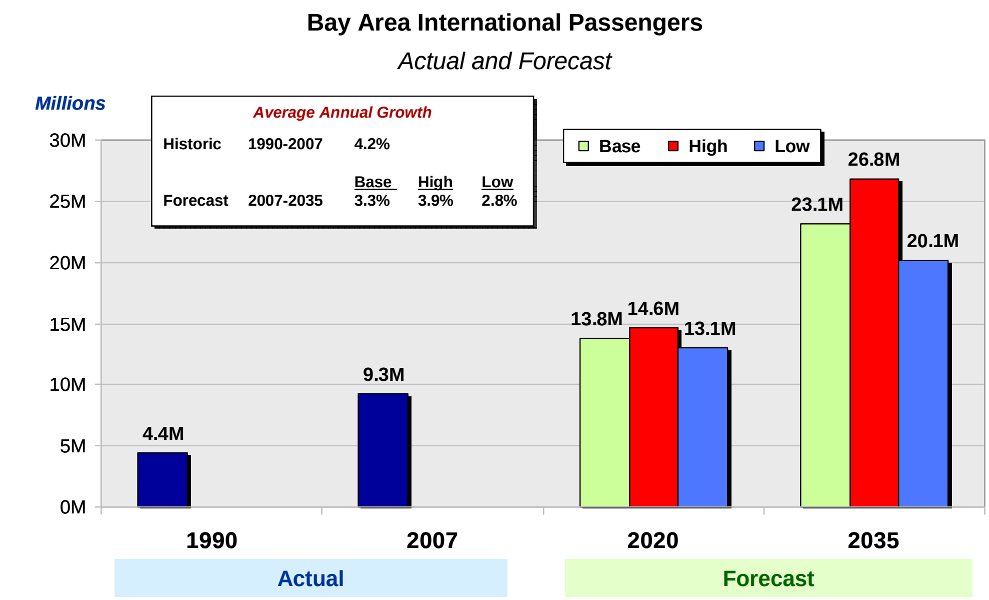
Australia is forecast to be the fastest growing region for Bay Area international passengers, growing by 5.5 percent per year in the Base Case forecast scenario. (See Exhibit 2-27) By 2035, annual passenger traffic between the Bay Area airports and Australia is forecast to reach 2.1 million. Asia is forecast to remain the largest region for Bay Area international passengers at 10.2 million in 2035 under the Base Case assumptions.

Exhibit 2-27 – Australia is Forecast to be the Fastest Growing Region for Bay Area International Passenger Traffic, Increasing by 5.5% per Year Over the Forecast Period



The range for the international passenger forecast, including connecting passengers, is shown in Exhibit 2-28. The Bay Area's international passenger demand in 2035 is forecast at 20.1 million passengers in the Low Case and 26.8 million in the High Case.

Exhibit 2-28 – The Forecast Range for Bay Area International Passenger Traffic is 20M to 27M in 2035



Note: Includes local and connecting passengers.

2.6 CONNECTING PASSENGERS

2.6.1 Connecting Passenger Forecast Approach

Connecting passengers are passengers that change planes at one of the Bay Area airports as part of their air journey. For example, a passenger traveling from New York JFK Airport to Santa Barbara Municipal Airport who changes planes at SFO is a local New York-Santa Barbara passenger, and a SFO connecting passenger. Because SFO is a connecting hub for United Airlines, it accounted for 87 percent of the Bay Area's 2007 connecting passengers. Connecting passengers are included in the forecast because the demand for the runway facilities at the Bay Area airports is a function of total passengers, i.e., local and connecting passengers.

There are three types of connecting passengers at the Bay Area airports:

Pure Domestic: These include passengers that connect from one domestic flight to another. For example, a passenger with a one-way itinerary of Fresno-SFO-Chicago O'Hare represents 2 connecting passengers at SFO - one deplaning plus one enplaning.

International Connecting[8]: These include passengers who arrived or departed on a domestic or international flight and then connected to an international flight and are counted as international enplaned or deplaned passengers in the airport statistics. For example, a passenger with a one-way itinerary of Boston-SFO-Tokyo is counted as an enplaned international passenger at SFO and represents one international connecting passenger.

Domestic Portion of International Journeys: These include passengers who arrived or departed on a domestic flight and connect to an international flight and are counted as a domestic enplaned or deplaned passenger in the airport statistics. For example, the same Boston-SFO-Tokyo passenger as described above is also counted as a domestic deplaned passenger at SFO and represents one additional connecting passenger. [9]

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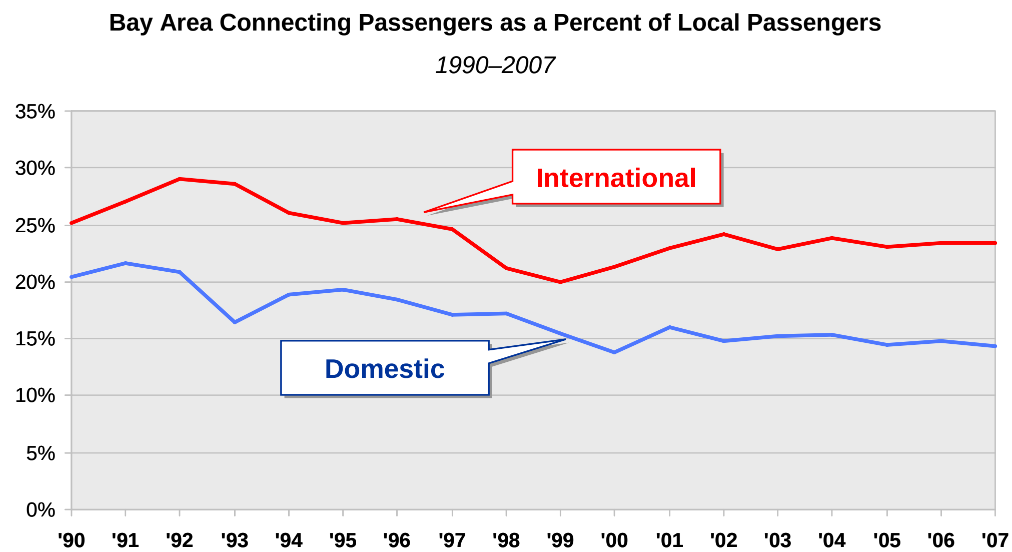
[8] These international connecting passengers were included in the forecast of international passengers described in Section 2.5 International Passenger Forecast.

[9] Note that the one-way Boston-SFO-Tokyo passenger counts as 2 passengers in the SFO passenger counts; once as a domestic deplaned and once as an international enplaned.

Pure domestic and international connecting passenger flows were forecast as ratios to local domestic and local international passenger flows respectively. As shown in Exhibit 2-29, the pure domestic and international connecting passenger ratios have been fairly constant since 2002. From 2002 to 2007, the average pure domestic connecting to local passenger ratio was approximately 0.15 and the average international connecting to local passenger ratio was 0.235. These ratios were used to forecast pure domestic and international connecting passengers for each of the growth scenarios. By holding the connecting ratios constant at recent actual connecting ratios, the forecast assumes that United Airlines, or a similar carrier, maintains a connecting hub at SFO over the forecast horizon.

Exhibit 2-29 – The Bay Area's Pure Domestic and Domestic-to-International Connecting Passenger Ratios have Been Fairly Stable Since 2002

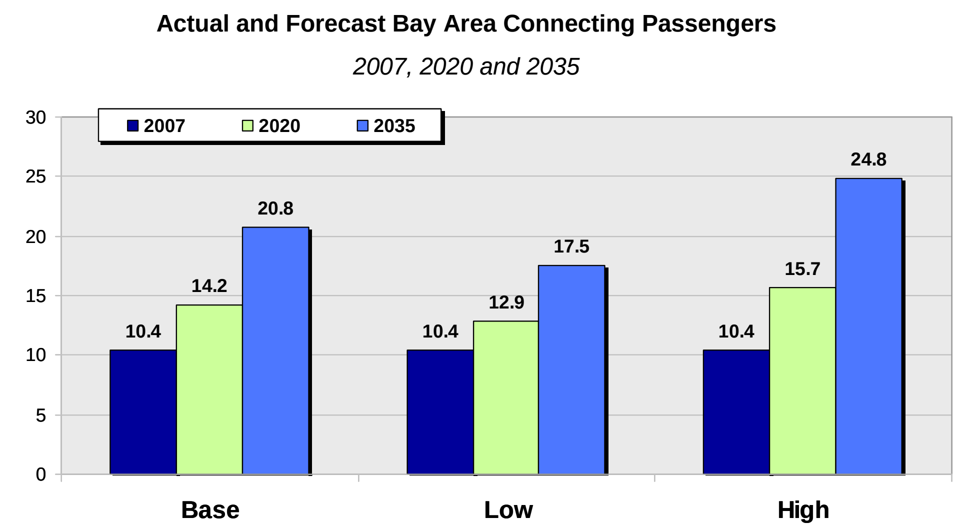


The connecting passengers that represent the domestic portion of international journeys were forecast in each growth case to increase at the same rate as international gateway passengers.

2.6.2 Connecting Passenger Forecast

In the Base Case, total Bay Area connecting passengers are forecast to reach 21 million in 2035. (See Exhibit 2-30) For the alternative growth scenarios, connecting passengers are forecast at approximately 18 million (Low Case) and 25 million (High Case).

Exhibit 2-30 – Bay Area Connecting Passengers are Forecast to Reach 18M to 25M in 2035



2.7 Regional Passenger Forecast Summary and Benchmarking

2.7.1 Total Forecast Passengers

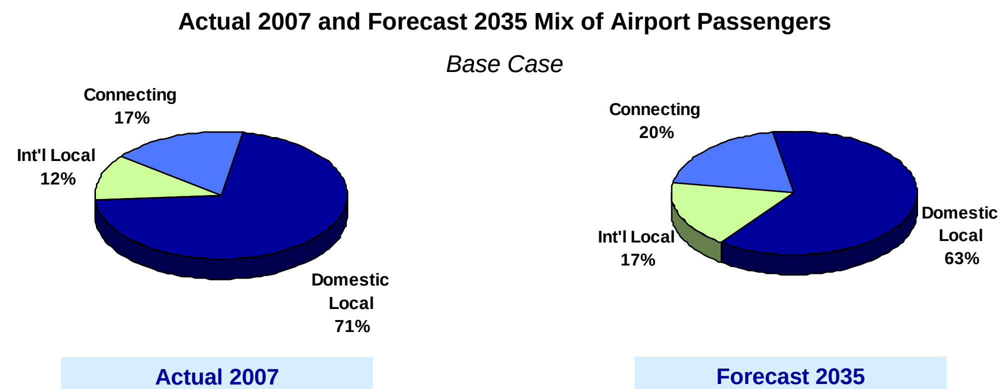
The long-term forecast of Bay Area airport passengers by growth scenario is shown in Exhibit 2-31. In 2035, total passenger demand for the Bay Area airports is forecast to range from 88 million to 129 million passengers. In the Base Case, total passengers are forecast to increase by 1.9 percent per year and reach 101 million in 2035. In all three scenarios, domestic local passengers are forecast to grow the slowest and international local passengers are forecast to increase the fastest. By 2035, the region is forecast to generate 64 million domestic local passengers and 18 million international local passengers, as well as 20 million connecting passengers, under the Base Case assumptions.

Exhibit 2-31 – Total Bay Area Airport Passengers are Forecast at 88M to 129M in 2035

Year	Base Dom Local	Base Int'l Local	Base Conn	Base Total	Low Dom Local	Low Int'l Local	Low Conn	Low Total	High Dom Local	High Int'l Local	High Conn	High Total
	Total Passengers (in millions)											
Base 2007	43.1	7.1	10.4	60.6	43.1	7.1	10.4	60.6	43.1	7.1	10.4	60.6
Forecast												
2020	50.8	10.5	13.9	75.3	45.8	10.0	12.9	68.7	60.0	11.2	15.7	86.9
2035	63.5	17.7	20.1	101.3	55.3	15.4	17.5	88.2	83.4	20.5	24.8	128.8
AAG												
2007-2020	1.3%	3.1%	2.3%	1.7%	0.5%	2.7%	1.7%	1.0%	2.6%	3.6%	3.2%	2.8%
2020-2035	1.5%	3.5%	2.5%	2.0%	1.3%	2.9%	2.1%	1.7%	2.2%	4.1%	3.1%	2.7%
2007-2035	1.4%	3.3%	2.4%	1.9%	0.9%	2.8%	1.9%	1.4%	2.4%	3.9%	3.2%	2.7%

Because international passenger traffic is forecast to increase the fastest, the international local and connecting passenger shares increase over the forecast period. As shown in Exhibit 3-32, international local passengers grow from 12 percent of total airport passengers to 17 percent in the 2035 Base Case. The connecting passenger share also increases from 17 percent to 20 percent.

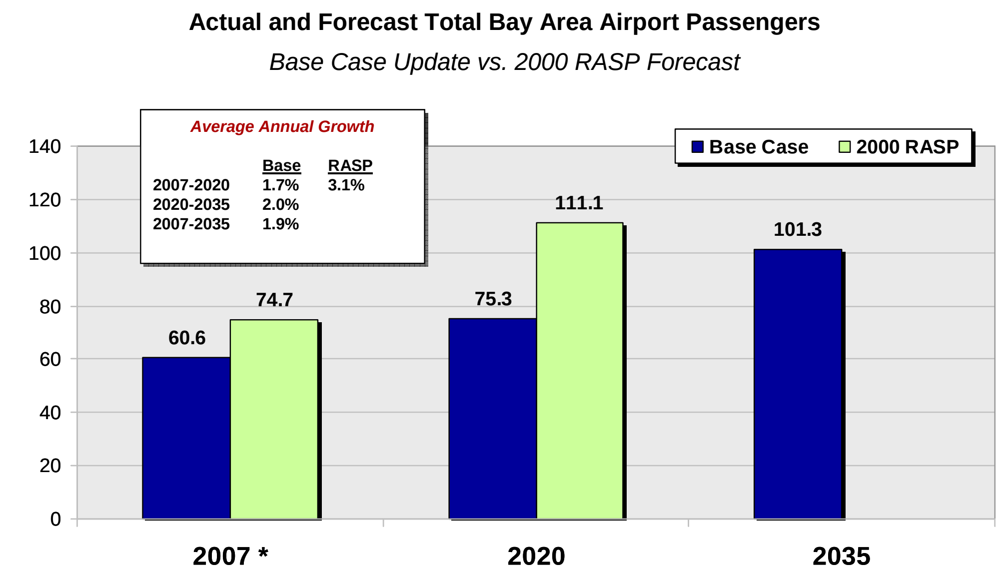
Exhibit 2-32 – Over the Forecast Period, the International Passenger Share is Forecast to Increase from 12% to 17% in the Base Case



2.7.2 Forecast Benchmarking

In this section, the updated Base Case passenger forecast is compared to the 2000 RASP forecast and the FAA's Terminal Area Forecasts (TAF) for the Bay Area airports. As shown in Exhibit 2-33, the long-term updated forecast of 101 million passengers in 2035 is approximately 9 percent lower than the 2000 RASP, which projected 111 million passengers in 2020. At 75 million passengers, the updated 2020 forecast is 32 percent below the 2020 forecast from the 2000 RASP.

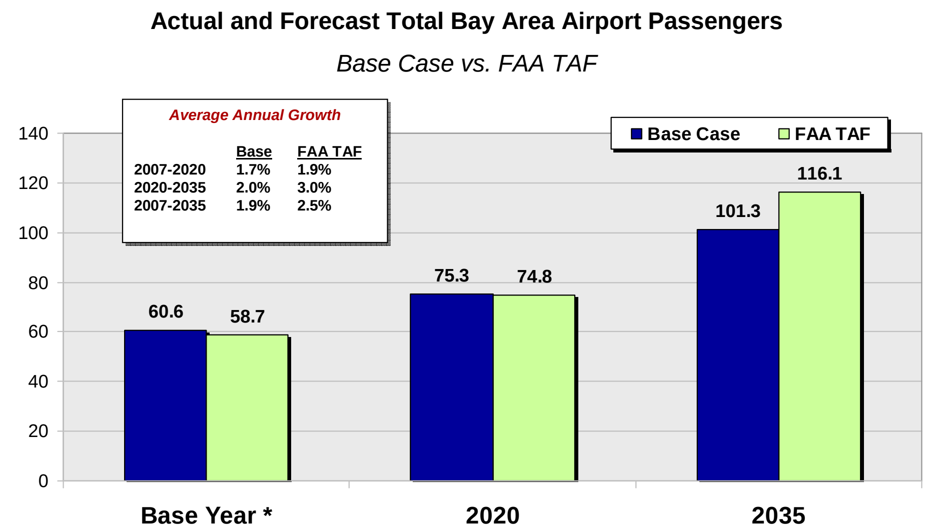
Exhibit 2-33 – The 2035 Base Case Forecast of 101M, is 9% Below the Previous Projection of 111M in 2020



* Base Case passenger number for 2007 is the actual passenger volume.
Source: RAPC, Bay Area 2000 Regional Airport System Plan Update 2000, Volume II

The updated Base Case passenger forecast for 2020 is similar to the FAA TAF at 75 million passengers. (See Exhibit 2-34) For the outer forecast year, 2035, the Base Case projection of 101 million is 12.7 percent lower than the FAA TAF, which is 116 million based on extrapolation.

Exhibit 2-34 – The Base Case Forecast is 12.7% Lower than the FAA Terminal Area Forecast for the Bay Area

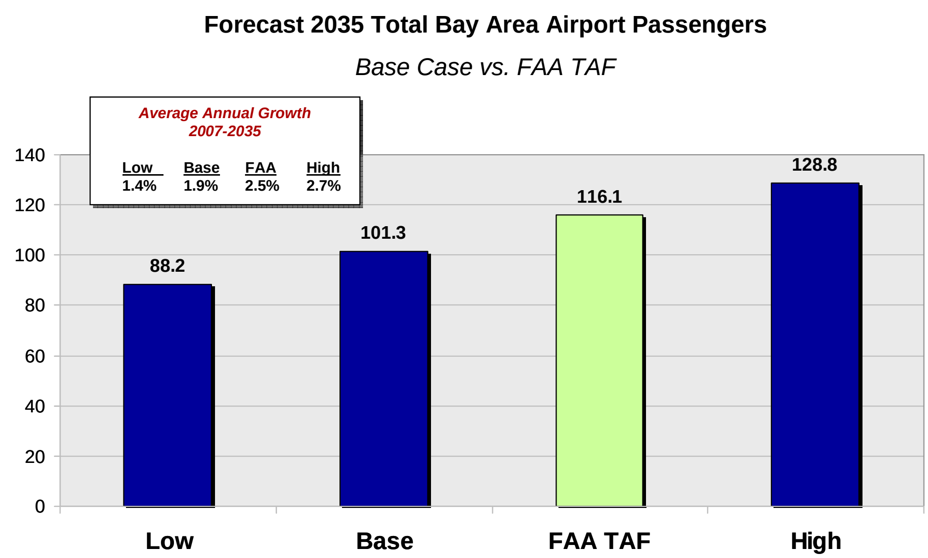


* Forecast base year is CY 2007. FAA base year is FYE October 2007.

Note: Reported airport traffic is higher than FAA airport statistics.
FAA forecast is for federal fiscal years ending September 30th.
FAA Forecast for 2035 is extrapolated from 2025 using 2024-2025 forecast growth rates.
Source: FAA, Terminal Area Forecasts, December 2008

If all forecast scenarios are compared to the TAF, the TAF forecast is approximately midway between the Base and High Cases. (See Exhibit 2-35)

Exhibit 2-35 – The Forecast Range Brackets the FAA TAF Forecast



Note: FAA Forecast for 2035 is extrapolated from 2025 using 2024-2025 forecast growth rates.

Source: FAA, Terminal Area Forecasts, December 2008

2.8 PASSENGER DISTRIBUTION BY AIRPORT

Because of the significant overlap between the market areas and associated passenger utilization of Oakland, San Jose and San Francisco, a region-wide forecasting approach was used to project future air passenger demand for the Bay Area. This section describes the assumptions and rationale that support the forecast distribution of the region's passenger traffic between the three primary commercial airports. To provide context to this process, several issues should be made explicit.

First, airline decisions regarding where their Bay Area flights will be concentrated among the three airports, and how their services will be priced at the individual airports, will have a substantial impact on the future distribution of passenger traffic and aircraft operations at OAK, SFO, and SJC. Since the Airline Deregulation Act of 1978, airlines can choose the airports they want to serve and the fares they want to charge. Thus they can respond to opportunities and economic decisions by entering or leaving a market quickly. In the Bay Area, there have been significant historic shifts in airline service patterns among the three airports and these shifts have led to changes in the individual airport passenger shares. Future airline decisions cannot be predicted with any precision so there is associated uncertainty in the forecasts of the individual airport market shares. With this inherent uncertainty, the objective was to arrive at a set of reasonable and documented assumptions regarding the factors that will drive the future airport traffic distribution, and to apply those assumptions in developing the airport specific forecasts.

Also, the airport passenger traffic forecasts are <u>unconstrained</u>, meaning that the forecast distribution of passengers and commercial airline flights between OAK, SFO, and SJC was not tempered by potential runway capacity constraints at the individual airports. The level of congestion and delay at each of the airports based on these unconstrained traffic forecasts will be quantified in a separate study task. The results of the capacity and delay modeling will determine whether the individual airports can reasonably accommodate the unconstrained traffic forecasts. If not, it will be necessary to address the potential responses of airlines and passengers and the extent to which capacity constraints at any of the Bay Area airports will lead to a re-distribution of passenger traffic and commercial airline operations among the airports.

The following sections describe the historic trends in the distribution of passengers between the primary Bay Area commercial airports, the dramatic shift in airport market shares that occurred between 2006 and 2008, the assumptions concerning future airport shares of the region's passengers, and the resulting traffic forecasts for OAK, SFO, and SJC.

2.8.1 Historic and Forecast Distribution of Bay Area Passengers Among the Primary Airports

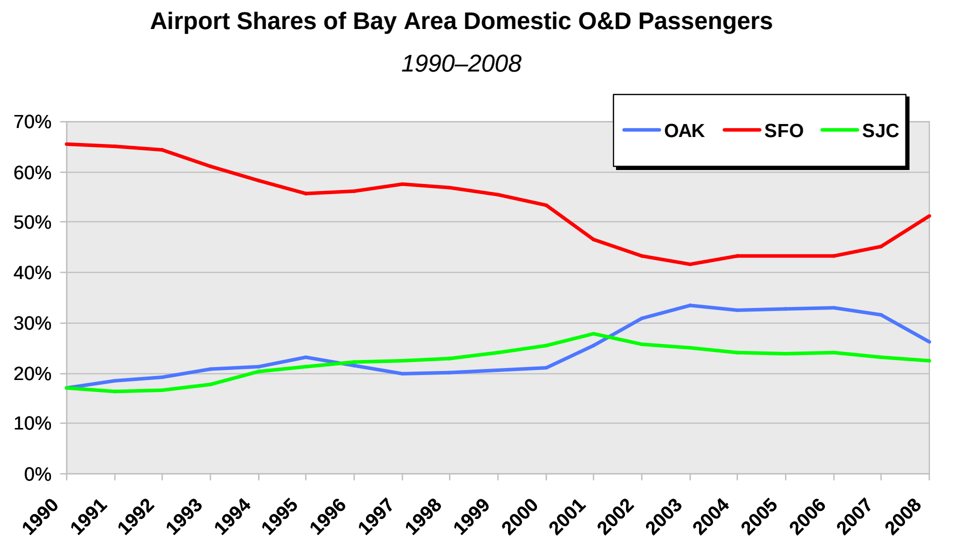
There are three primary segments of passenger traffic at the Bay Area airports: domestic O&D passengers, international O&D passengers, and connecting passengers. Domestic O&D passengers are the dominant segment of the region's air travel demand and also represent the segment that has the greatest degree of overlap or competition between the three primary airports. As described in Section 1.4.1, domestic passengers comprised 71 percent of total Bay Area passengers in 2007. International O&D passengers represented 12 percent of total Bay Area passengers and connecting passengers accounted for 17 percent.

The market shares at OAK, SFO, and SJC vary widely across these three traffic segments with San Francisco dominating the international (96 percent) and connecting passenger (87 percent) segments, but with a more balanced distribution of domestic O&D passengers across the three airports. Just as the region-wide passenger traffic forecast was developed by combining separate forecasts for each traffic segment, the individual airport traffic forecasts reflect separate analysis of the three segments of Bay Area passenger traffic.

Distribution of Domestic O&D Passengers

The distribution of Bay Area domestic O&D passengers between OAK, SJC, and SFO from 1990 through 2008 is shown in Exhibit 2-36. Across the 18 year historic period, SFO has consistently attracted the largest share of the region's domestic passengers, although its share declined from approximately 66 percent in 1990 to a low of 42 percent in 2003. However, between 2006 and 2008, San Francisco's share of the Bay Ares domestic passengers jumped sharply, rising from 43 to 51 percent.

Exhibit 2-36 – After Losing Domestic O&D Traffic Share to OAK and SFO for Many Years, SFO's Share Increased from 2006 to 2008

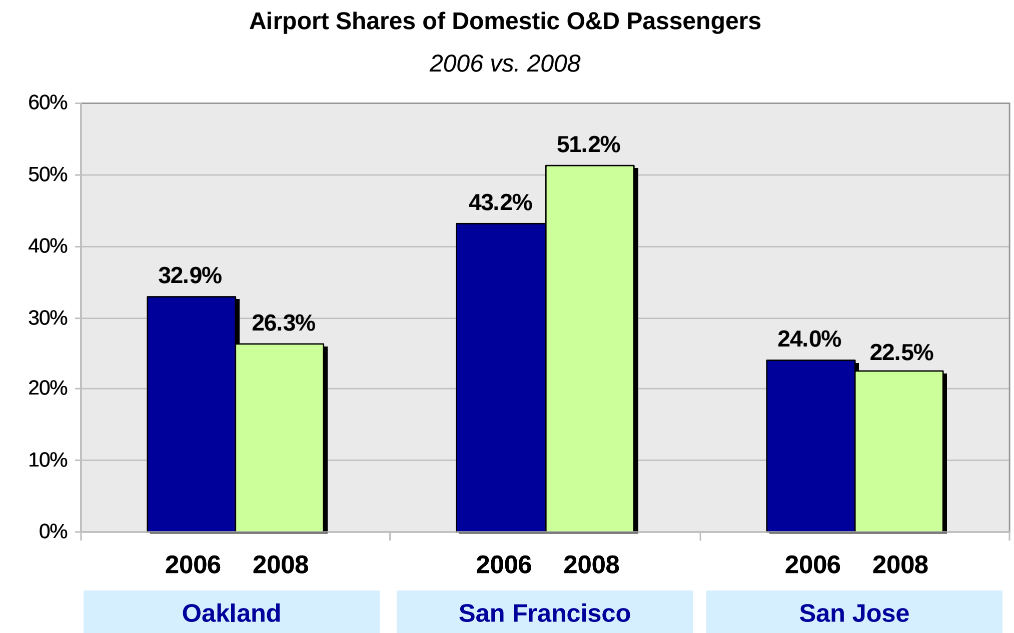


Source: SH&E analysis of US DOT, O&D Survey and T-100 databases and Airport reported traffic statistics.

Oakland's share of Bay Area domestic O&D passengers nearly doubled between 1990 and 2003 (from 17 to 33 percent), but the airport has lost nearly 3 million domestic passengers over the past two years and its domestic market share dropped from 33 percent to 26 percent. San Jose attracted an increasing share of Bay Area domestic traffic between 1990 and 2001 (rising from 17 to 28 percent), but has experienced a gradual decline in market share since 2002. From 2006 to 2008, SJC's share of Bay Area domestic O&D passengers declined from 24.0 to 22.5 percent.

The substantial shift in domestic O&D traffic between the Bay Area airports that occurred between 2006 and 2008 is illustrated below in Exhibit 2-37. A major factor contributing to the increase in domestic traffic and market share at OAK and SJC during the 1990's and early 2000's, and the substantial shift to SFO over the past two years, relates to the presence and growth of LCC services at the Bay Area airports. Over the past 15 years, LCCs have attracted a steadily increasing share of domestic traffic on a national basis and have exhibited consistent growth in flight volume, seat capacity and markets served. In contrast, the legacy or network carriers such as United Airlines, American Airlines, and others have contracted domestically and transferred portions of their domestic service to regional carrier affiliates.

Exhibit 2-37 – From 2006 to 2008, There Was a Major Shift of Domestic Traffic From OAK to SFO

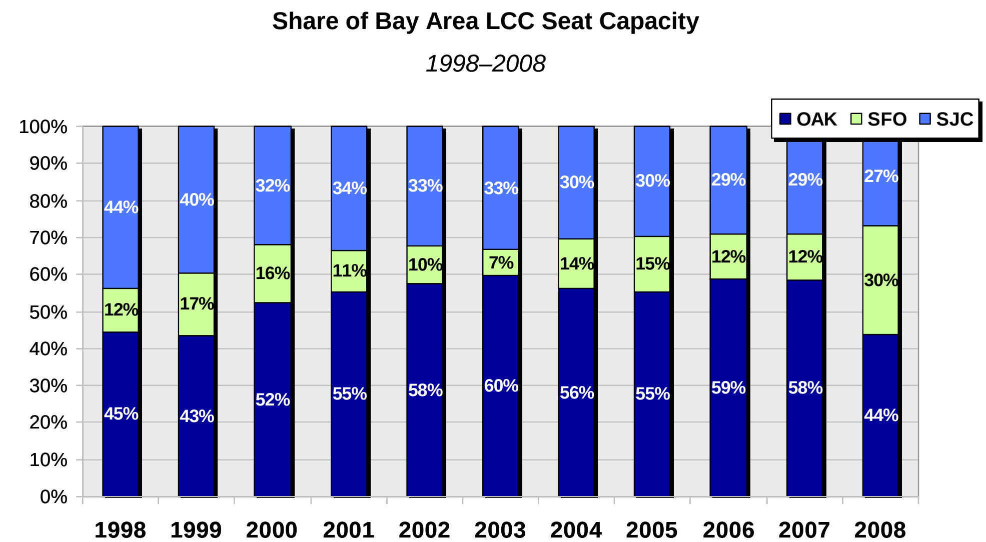


Source: U.S. DOT Origin and Destination Survey, Airport Records, SH&E Analysis

Southwest Airlines is the largest U.S. low cost carrier and the dominant LCC in the Bay Area market. Southwest expanded services rapidly at OAK and SJC during the 1990's, while maintaining a small presence at SFO. However, in March 2001, Southwest withdrew completely from SFO, electing to serve the Bay Area market exclusively from OAK and SJC.

In 1998, Oakland and San Jose had approximately equal shares of the region's total low cost carrier capacity and together accounted for 88 percent of total LCC seat departures from the Bay Area. (See Exhibit 2-38) Oakland's share of LCC service from the Bay Area rose further, peaking at 60 percent in 2003 before dropping sharply between 2007 and 2008.

Exhibit 2-38 – Since Southwest Airlines Re-Entered the SFO Market, LCC Capacity Has Shifted from OAK to SFO



Source: OAG, August 1998 to 2008

San Jose's share of region-wide LCC service dropped significantly in CY 2000, stabilized for the next three years, and has declined gradually since 2003 (from 33 to 27 percent). While SJC's share of total Bay Area LCC services has declined over the past four years, the absolute levels of LCC departures and seat capacity provided at SJC actually increased over the period.[10] San Francisco's share of Bay Area LCC service has jumped from 12 to 30 percent over the past two years with LCC flight departures tripling from 34 to 100 per day between August of 2007 and 2008. The dramatic growth in SFO's LCC services was triggered when Virgin America, a much publicized U.S. LCC start-up, announced plans to make San Francisco its headquarters and base of operations. Even prior to the Virgin America launch, JetBlue initiated service at SFO and Southwest Airlines re-entered the SFO market.

To better understand the impacts of the growth in LCC service at SFO on airport shares of Bay Area domestic passenger traffic, it is helpful to look at the domestic market segment in greater detail. Exhibit 2-39, shows that Bay Area domestic traffic is highly concentrated across its top destination markets. The 15 largest Bay Area markets in FY 2008 accounted for 63 percent of total domestic passengers. While LAX is the Bay Area's top destination with 8.3 percent of domestic traffic, the five

[10] This is explained by increasing LCC competition at the other Bay Area airports, first at Oakland (from 2003-2007) and then at San Francisco.

Los Angeles area airports—including LAX and Orange County, Burbank, Ontario and Long Beach—accounted for 20 percent of Bay Area domestic passengers. Including San Diego, the 3rd largest Bay Area destination, the overall Southern California market represented over 26 percent of the Bay Area's domestic passengers. This high concentration of Bay Area passenger traffic to and from Southern California markets is a significant factor in the evaluation of future High Speed rail service and its potential to provide relief to future capacity constraints in the Bay Area aviation system.

Exhibit 2-39 – The Bay Area's Domestic O&D is Highly Concentrated, with the Top 15 Markets Account for 63% of the Total

Bay Area Top Domestic O&D Markets

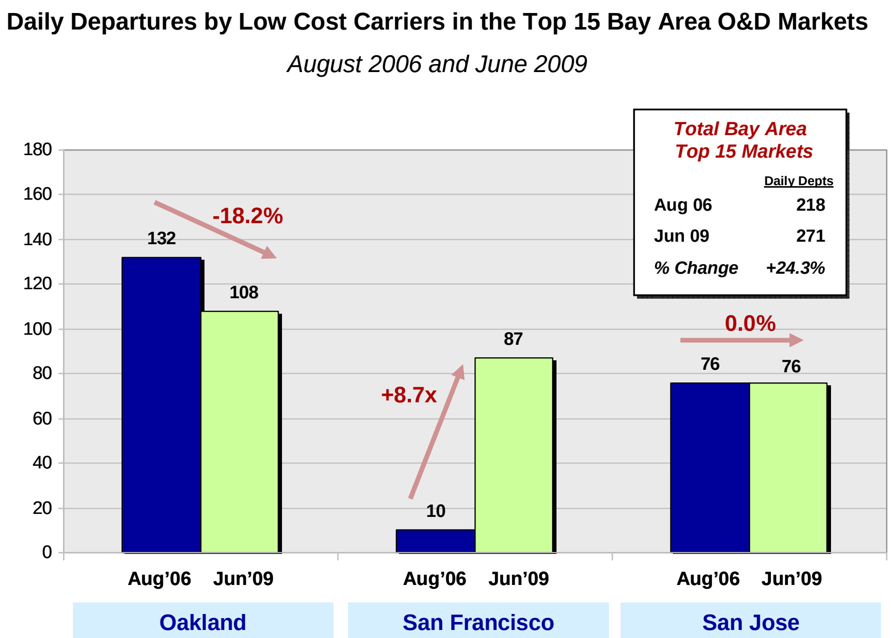
YE 3Q 2008

YE3Q08 Rank	Market	Code	YE3Q08 Bay Area O&D Psgrs	Percent of Bay Area Domestic O&D
1	Los Angeles	LAX	3,351,490	8.3%
2	New York	NYC	2,852,740	7.1%
3	San Diego	SAN	2,524,880	6.3%
4	Las Vegas	LAS	2,344,990	5.8%
5	Seattle/Tacoma	SEA	1,915,000	4.8%
6	Orange County	SNA	1,575,010	3.9%
7	Chicago	CHI	1,503,160	3.7%
8	Burbank	BUR	1,493,430	3.7%
9	Phoenix	PHX	1,285,630	3.2%
10	Denver	DEN	1,190,230	3.0%
11	Washington	WAS	1,163,430	2.9%
12	Portland	PDX	1,159,690	2.9%
13	Boston	BOS	1,098,970	2.7%
14	Ontario	ONT	1,006,180	2.5%
15	Dallas/Fort Worth	DFW	823,840	2.0%
	Total Top 15 markets		**25,288,670**	**62.8%**
	Total -- All markets		**40,259,950**	**100.0%**

Source: U.S. DOT O&D Survey

Because the 15 largest destinations represent such a high share of the Bay Area's domestic traffic, changes in airport shares within these top markets drive the overall distribution of domestic passengers by airport. Exhibit 2-40 shows the changes in low cost carrier services at OAK, SFO, and SJC in the top 15 markets that have occurred since 2006 when OAK and SJC attracted a combined 57 percent of the region's domestic O&D passengers.

Exhibit 2-40 – LCCs Greatly Increased SFO Services in the Top 15 Bay Area Domestic Markets, While LCC Flights Decreased at OAK and Remained the Same at SJC

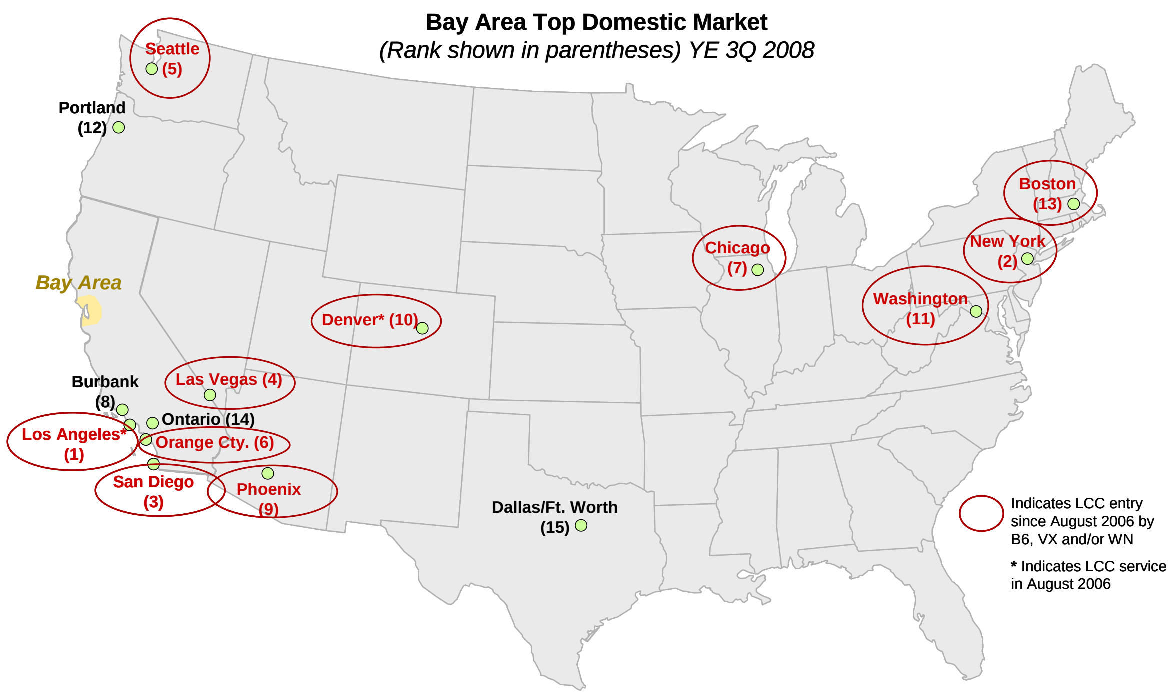


Source: OAG

Daily LCC departures from OAK to the top 15 Bay Area markets dropped from 132 to 108 between August 2006 and June 2009. At SJC, LCC flights to these destinations held constant at 76 per day. The major change occurred at SFO, which experienced almost a nine-fold increase, with LCC departures to the top 15 markets increasing from 10 to 87 per day.

Due to the entry of Virgin America, Southwest Airlines and JetBlue, SFO now has nonstop LCC service in 11 of the top 15 Bay Area markets (See Exhibit 2-41). In contrast, as of August 2006, SFO received LCC service in just two of these markets—Denver and LAX—from Frontier Airlines.

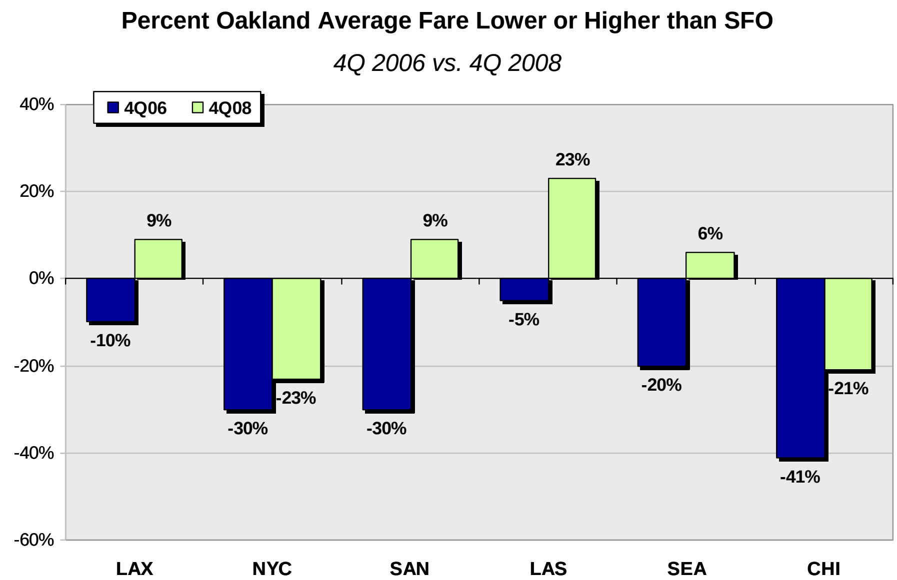
Exhibit 2-41 – SFO Now Has LCC Services in 11 of the Bay Area's Top 15 Domestic O&D Markets, Compared to Only Two Markets in 2006



Source: OAG and U.S. DOT O&D Survey.

These new LCC services at SFO have had a major impact on the comparative fare levels available at the three primary Bay Area airports. Exhibit 2-42 shows that the fare level advantage that OAK had over SFO in six of the top seven domestic markets in the 4th quarter of 2006 had been reversed or significantly diminished by 2008. For example, the average fare at OAK to LAX was 10 percent lower than at SFO in 2006. However, by 2008 OAK's average fare to LAX was 9 percent higher than at SFO. The change was even more significant in the San Diego market, where OAK's 2006 fare advantage of 30 percent had turned into a fare disadvantage of 9 percent versus SFO—a swing of 39 percent.

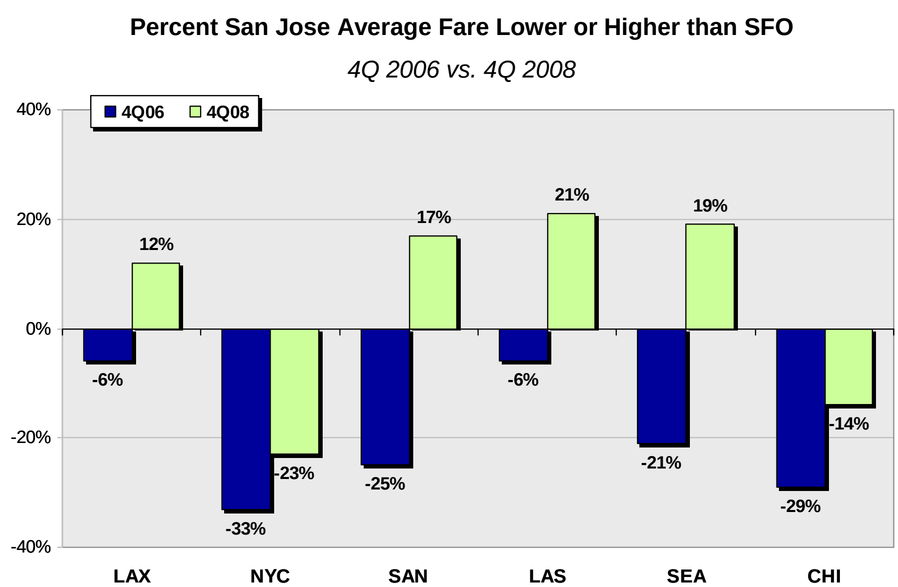
Exhibit 2-42 – LCC Entry at SFO Reversed or Significantly Reduced Oakland's Historic Fare Advantage



Note: The 6 markets shown each has significant LCC carrier entry at SFO as of 4Q 2008.
Source: U.S. DOT O&D Survey

Similar changes occurred at San Jose where 2006 fare savings relative to SFO had also been reversed or greatly reduced by the end of 2008 (see Exhibit 2-43).

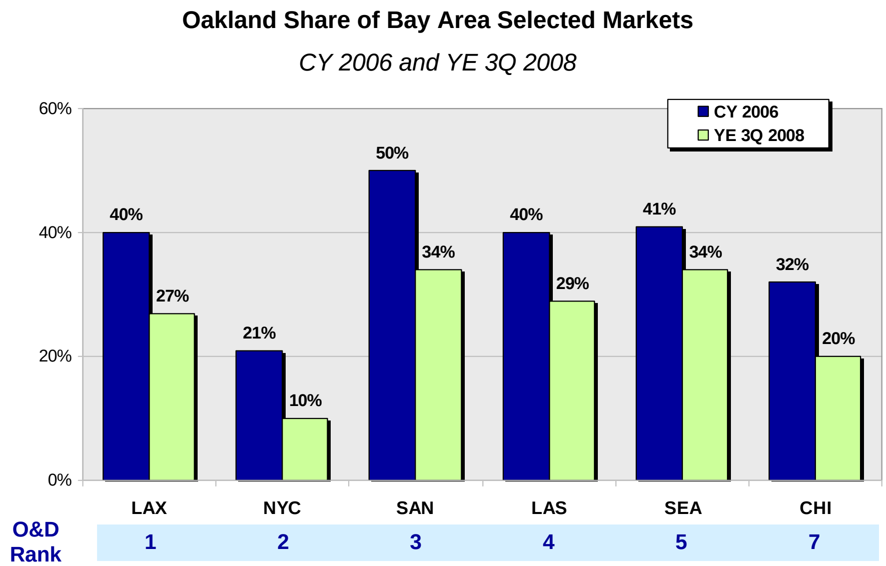
Exhibit 2-43 – LCC Entry at SFO had a Similar Effect on San Jose's Historic Fare Advantage



Note: The 6 markets shown each has significant LCC carrier entry at SFO as of 4Q 2008.
Source: U.S. DOT O&D Survey

Significantly reduced fares at SFO and the elimination (or diminishment) of historic fare savings available to Bay Area passengers choosing to fly from OAK and SJC has had a major impact on airport selection. Exhibit 2-44 illustrates the reduction in Oakland's share of total Bay Area passengers that occurred between 2006 and FY 2008 in top ranked domestic markets.

Exhibit 2-44 – Oakland's Share of Bay Area O&D Passengers Dropped Substantially in Top O&D Markets



Source: U.S. DOT O&D Survey

OAK lost an average of 12 percentage points in market share in these leading domestic markets, contributing significantly to its overall traffic loss and the shift in the region's domestic traffic to SFO. Similar share reductions were experienced at SJC, but the declines were less pronounced.

The changes in airport shares exhibited between 2006 and 2008 will be magnified in 2009, as intense airline competition continues at SFO, the impact of service losses at OAK including the complete withdrawal of American Airlines and Continental and the failure of Skybus, Aloha and ATA is fully reflected, and San Jose traffic levels start to exhibit the effects of service reductions that occurred in late 2008 and the first half of 2009. During the first quarter of 2009, airport traffic data shows that total Bay Area passengers had fallen by 14 percent with passenger traffic at OAK dropping by 32 percent, SJC passenger volume down by 20 percent, and passenger traffic at SFO down by 6 percent compared to the first quarter of 2008. The steeper declines at

OAK and SJC indicate that SFO will continue to increase its share of domestic local passengers in 2009, with both OAK and SJC experiencing additional share reductions from their already reduced 2008 levels.

Forecast of Bay Area Airport Shares of Domestic Passenger Traffic

In forecasting the future distribution of Bay Area domestic passengers across the three primary airports, it was assumed that Oakland and San Jose will both experience a rebound in market share from the depressed 2008 levels and the even lower shares expected in 2009. The forecast assumes that both OAK and San Jose will attract shares of the region's domestic O&D passengers that are half way between the strong shares exhibited in 2006 and the reduced shares in 2008.

The primary factors supporting this assumption are:

- The current level of intense service and fare competition at SFO is undoubtedly causing airlines such as Virgin America, United, Southwest and Alaska to experience operating losses in key West Coast markets as they fight to retain (or gain) competitive position and market share. This level of competition is not sustainable over the long term and will eventually subside.
- When this occurs, the three primary Bay Area airports should move toward fare parity in markets where today, SFO has a fare level advantage over OAK and SJC.
- This fare parity should encourage some passengers who are now choosing SFO due to fare savings to switch back to OAK or SJC.
- The portions of the Bay Area region closest to OAK and SJC (versus SFO) are forecast to exhibit stronger demographic growth[11] than the urban core around San Francisco. While this growth will lead to only small gains in the shares of total Bay Area passengers that originate trips from ground locations geographically closer to OAK and SJC[12], this faster growth should encourage some market share gain at these two airports.

The recent and forecast airport shares of domestic O&D passengers are summarized in Exhibit 2-45. In both forecast years, 2020 and 2035, OAK is forecast to attract 29.6 percent of the Bay Area domestic local passenger demand and SJC's share is

[11] Based on ABAG's forecasts of population and average household income from *Projections 2007*.
[12] The shares of Bay Area domestic trips forecast to originate from ground locations geographically closer to OAK or SJC, as opposed to SFO are expected to increase by approximately one percentage point at each airport, based on study team analysis.

forecast at 23.2 percent. SFO is forecast to remain the dominant airport for domestic local passenger with a 47.2 percent share.

Exhibit 2-45 – Actual and Forecast Bay Area Airport Shares of Domestic O&D Passengers

Domestic O&D Passenger Shares

Airport	Actual 2006	Actual 2008	Forecast 2035
OAK	32.9%	26.3%	29.6%
SFO	43.2%	51.2%	47.2%
SJC	24.0%	22.5%	23.2%

The forecast domestic market share at OAK and SJC was not taken all the way back to the levels these airports experienced in 2006. This is because in 2006, SFO had extremely limited service by low cost carriers and was at a significant fare disadvantage relative to OAK and SJC. This would have encouraged some passengers located more conveniently to SFO to drive further to OAK or SJC to take advantage of lower fares. The airport distribution in 2006 was out of balance, and low cost carriers are assumed to remain at SFO for the long term. As a result, SFO will not exhibit the fare penalties present in 2006 and should not return to the depressed market share that it had in that year.[13]

Distribution of International Gateway Passengers

In 2008, the Bay Area airports served 9.3 million international passengers, representing 16 percent of total passenger traffic at the three primary airports. These international passengers, including both local O&D and connecting passengers, were highly concentrated at SFO, which handled almost 97 percent of total Bay Area international traffic. San Francisco is a leading U.S. international gateway airport, particularly to Asia where SFO is the second largest U.S. gateway behind only LAX. Transoceanic markets in Asia, Europe, and Australia/Oceania account for nearly 75 percent of the Bay Area's international traffic, with the remaining international passengers flowing to Canada, Mexico and Latin America.

[13] Capacity constraints and high delays could lead to future fare penalties at SFO, but this possibility was not considered in this unconstrained forecast. If the capacity and delay analysis indicates that the unconstrained forecast and associated aircraft operations exceed the capacity of the SFO airfield, this study will address the possibility of passenger re-distribution from SFO to OAK and SJC.

SFO has served a dominant share of Bay Area international passengers throughout the historic period, with a market share of at least 92 percent since 1990. American Airlines established a secondary international gateway at San Jose that operated from 1991 to 2006. The American Airlines SJC gateway at its peak provided nonstop flights to Tokyo, Paris, Taipei and Vancouver, and was fed by a network of domestic services including East Coast transcontinental markets and major West Coast and Central U.S. cities. However, the American gateway at SJC never attracted more than 5.1 percent of the Bay Area's international passengers (410,000 passengers in 2001) and was discontinued in October 2006. Currently, SJC and OAK both receive limited international services to markets only in Mexico.

Over the forecast period through 2035, the forecast assumes that SFO will maintain its position as the Bay Area's dominant international gateway airport. The forecast does not assume a resumption of long-haul transoceanic services at SJC because the American Airlines initiative was unsuccessful. However, it is forecast that both SJC and OAK will gain increased penetration of the Mexican market, and will receive new services to major markets in Canada which neither airport receives currently. Mexico and Canada are both transborder markets, and services to these countries are similar to domestic U.S. services (i.e., in terms of distances and aircraft types) where both OAK and SJC maintain significant presence and market share today.

Exhibit 2-46 summarizes the forecast assumptions for the distribution of international passengers across the three Bay Area airports. These international passenger shares include Bay Area international O&D passengers and passengers from other cities (predominately U.S.) who connect onto international flights to and from the Bay Area. Oakland's share is assumed to increase from 1.9 percent in 2008 to 3.5 percent in 2020 and 2035, reflecting an increase in transborder services. Similarly, SJC's share increases from 1.4 percent in 2008 to 3.4 percent over the forecast period. SFO's future share of forecast international passengers declines slightly from 96.7 percent in 2008 to 93.1 percent in 2020 and 2035.

Exhibit 2-46 – Actual and Forecast Bay Area Airport Shares of International Gateway Passengers

International Gateway Passenger Shares

Airport	Actual 2006	Actual 2008	Forecast 2035
OAK	2.2%	1.9%	3.5%
SFO	94.8%	96.7%	93.1%
SJC	3.0%	1.4%	3.4%

Note: Includes local and connecting passengers.

These international passenger traffic forecasts include Bay Area international O&D passengers and passengers from other cities (predominately U.S.) who connect onto international flights to and from the Bay Area.

Connecting Passenger Forecasts

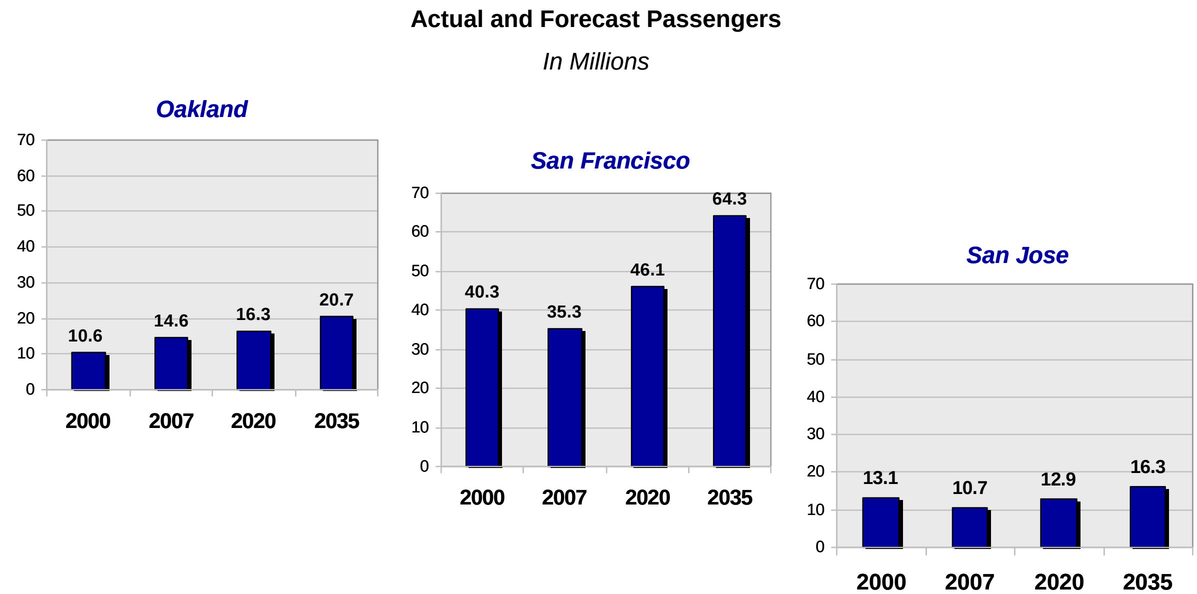
After forecasting future domestic O&D and international gateway passengers and market shares for each of the primary Bay Area airports, it was necessary to forecast domestic connecting passengers. These passengers include both "pure domestic" connecting passengers, who connect at a Bay Area airport while traveling between two U.S. cities, and domestic to international connecting passengers who are connecting at a Bay Area airport (i.e., SFO) when traveling between another U.S. city and an international destination.

The ratio of pure domestic connecting passengers to domestic O&D passengers has been reasonably stable at each of three Bay Area airports. Therefore, the average ratio from the 2006 to 2008 period at each airport was applied to the airport's forecasted domestic O&D passengers to project its pure domestic connecting traffic. Similarly, domestic to international connecting passengers at SFO, OAK, and SJC were forecast as a ratio to each airport's international gateway passenger forecast. In this case, the average ratio from 2007 and 2008 was utilized since the remaining elements of American Airline's international gateway at SJC (i.e., Tokyo service) in 2006 increased the SJC connecting ratio in that year.

2.8.2 Summary of the Traffic Forecasts for OAK, SJC and SFO

Exhibit 2-47 summarizes the Base Case unconstrained forecasts of passenger traffic in 2020 and 2035 for each of the Bay Area's primary commercial airports. At Oakland, passenger traffic is forecast to increase from 14.6 million in 2007, its peak traffic level, (and 11.5 million in 2008) to 20.7 million passengers in 2035. San Francisco's passenger traffic is projected to increase from 35.3 million in 2007 to 64.3 million in 2035. At San Jose, passenger traffic is not forecast to reach its 2000/2001 peak level of 13.1 million until after 2020. In 2035, unconstrained demand for SJC is forecast at 16.3 million passengers.

Exhibit2-47 - Unconstrained Forecast of Total Passenger Traffic at the Primary Bay Area Airports, *Base Case*



Source: SH&E forecast.

The forecast growth rates for each airport and the region as a whole are shown in Exhibit 2-48. Oakland's 2035 forecast represents 1.2 percent annual growth in passenger traffic from the 2007 base year. It should be noted that the traffic growth rate at Oakland increases to 2.2 percent if calculated off the airport's lower traffic level in 2008. San Jose's traffic is forecast to grow at an average annual rate of 1.5 percent from the 2007 level, while San Francisco's traffic is projected to increase at 2.2 percent per year between 2007 and 2035.

Exhibit 2-48 – From 2007 to 2035, Airport Passengers Increase by 1.2% to 2.2% Annually

Note: San Francisco is forecast to grow the fastest because long-haul international traffic is forecast to grow faster than domestic traffic.

Source: SH&E forecast.

Passenger traffic for the overall Bay Area region is forecast to increase by 1.9 percent annually between 2007 and 2035. In considering the comparative growth rates by airport, the fact that SFO is forecast to exhibit the highest growth rate from 2007 through 2035 is largely influenced by its dominant share of the region's international traffic. In the region-wide forecast, international passengers are forecast to grow at more than twice the rate as the region's domestic passengers.

The forecast mix of passengers at each airport for the Base Case scenario is shown in Exhibit 2-49. At OAK and SJC, 9 out 10 passengers in 2035 are forecast to be domestic local passengers. In contrast, less than half of SFO's 2035 forecast passengers (47 percent) are domestic local. SFO accounts for 93 percent of the region's forecast international local passengers in 2035 and nearly 90 percent of connecting passengers.

Exhibit 2-49 – Actual and Forecast Bay Area Passengers by Airport, *Base Case*

Year / Category	Enplaned/Deplaned Passengers (millions)			
	OAK	SFO	SJC	Total
Actual 2007				
Domestic Local	13.6	19.5	10.0	43.1
International Local	0.1	6.9	0.1	7.1
Connecting	0.9	9.0	0.5	10.4
Total	14.6	35.3	10.7	60.6
Forecast 2020				
Domestic Local	15.0	24.0	11.8	50.8
International Local	0.3	9.9	0.3	10.5
Connecting	1.0	12.3	0.7	13.9
Total	16.3	46.1	12.9	75.3
Forecast 2035				
Domestic Local	18.8	30.0	14.8	63.5
International Local	0.6	16.5	0.6	17.7
Connecting	1.3	17.9	1.0	20.1
Total	20.7	64.4	16.3	101.3

Source: SH&E forecast.

Exhibit 2-50 summarizes the unconstrained forecast of total enplaned/deplaned passengers by airport for each forecast year and growth scenario. The forecast passenger range for Oakland is 18.0 million in the Low Case to 27.0 million in the High. SFO passengers are forecast at 56.0 million in the Low Case to 80.4 million in the High Case. The forecast passenger level at SJC varies from 14.2 in the Low to 21.3 in the High.

See Appendix B for the distribution of domestic and international passengers by airport for each growth scenario.

Exhibit 2-50 – Actual and Forecast Bay Area Passengers and Average Annual Growth Rates by Airport and Forecast Scenario

	Enplaned/Deplaned Passengers (millions)			
Year	OAK	SFO	SJC	Total
Actual				
2007	14.6	35.3	10.7	60.6
2008	11.5	37.1	9.7	58.3
Forecast - Base				
2020	16.3	46.1	12.9	75.3
2035	20.7	64.4	16.3	101.3
AAG 2007-2035	1.2%	2.2%	1.5%	1.9%
Forecast - Low				
2020	14.7	42.3	11.6	68.7
2035	18.0	56.0	14.2	88.2
AAG 2007-2035	0.7%	1.7%	1.0%	1.4%
Forecast - High				
2020	19.2	52.5	15.1	86.9
2035	27.0	80.4	21.3	128.8
AAG 2007-2035	2.2%	3.0%	2.5%	2.7%

Source: SH&E forecast.

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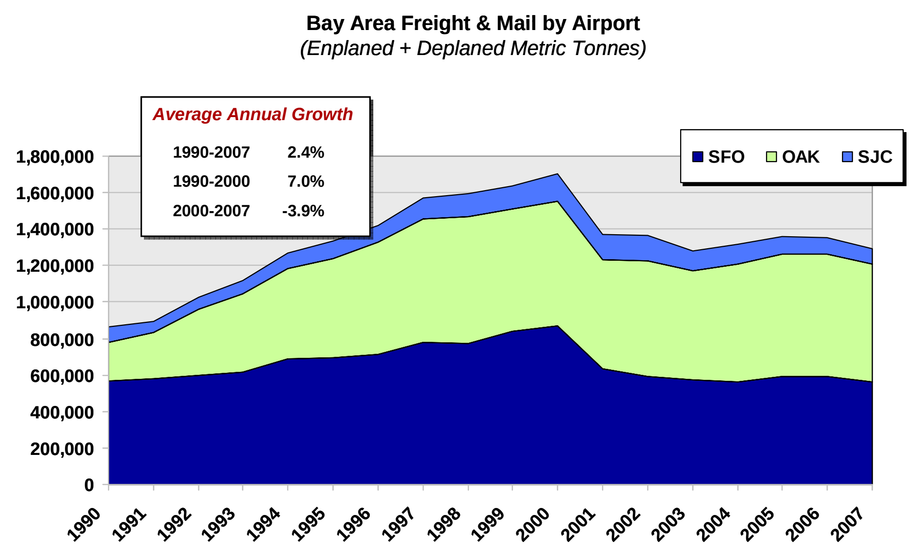
3 AIR CARGO VOLUME FORECAST

3.1 HISTORICAL TRENDS

3.1.1 Bay Area Air Cargo Growth Trends

Air cargo volume[14] at the Bay Area airports has declined sharply since 2000 when the previous RASP forecasts were prepared. From 2000 to 2007, freight and mail volume at the Bay Area airports fell by approximately 4.0 percent per year after growing at a rate of seven 7.0 percent annually from 1990 to 2000. (See Exhibit 3-1) At OAK, the largest of the three airports in terms of cargo activity, air cargo fell by 1.2 percent per year. SJC, which handled only 6 percent of the region's cargo in 2007, experienced the steepest decline at 7.9 percent per year. Annual cargo volume at SFO, the primary Bay Area airport for international cargo, fell by 6.1 percent per year.

Exhibit 3-1 – Total Cargo at the Bay Area Airports Has Declined Sharply Since 2000

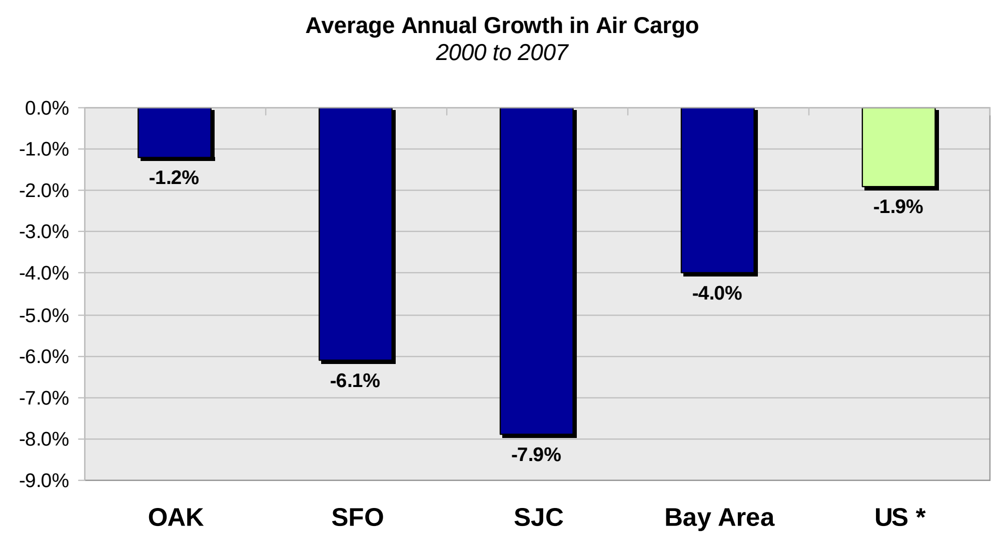


Source: Airports Council International

[14] Air cargo includes freight, small/package express shipments, and mail.

The U.S. also experienced a decline in air cargo tons from 2000 to 2007, when air cargo tons for the nation's largest airports declined by 1.9 percent per year. Several factors contributed to a declining trend in overall U.S. air cargo tons. First, the U.S. domestic air cargo market has matured. Rapid growth in the 1980s and 1990s was largely driven by the growth of the integrated express carriers and the introduction of new time-definite delivery services. However, since 2000, shipments by the integrated carriers have flattened, indicating that the express market, which accounts for approximately one-third of all U.S. domestic air cargo, has matured. Price competition from alternative shipping modes, i.e., trucking for domestic cargo and maritime for international cargo, has also slowed the growth of U.S. air cargo activity. Also, as the use of second-day delivery services grew over the past several years, the integrated carriers have significantly increased the use of trucking which has proven to be a more economical mode for their delayed delivery products. In addition, the widespread acceptance of e-mail and on-line transactions has lowered the use of both traditional mail delivery through the U.S. Postal service and the use of overnight express delivery services. Finally, the use of just-in-time inventory management practices, which fueled some of the rapid growth in air cargo seen in the 1990s, has also matured.

Exhibit 3-2 – Air Cargo at the Bay Area Airports Fell at a Faster Rate than the U.S. Air Cargo Market



U.S. based on cargo reported by top 60 U.S. airports, excluding Anchorage (used for technical stops) and primary integrator sort hubs – MEM/FedEx and SDF/UPS - to avoid double counting.

Sources: ACI, Airport Cargo Statistics; Airport Statistical Reports; U.S. DOT, T-100 On-flight Database

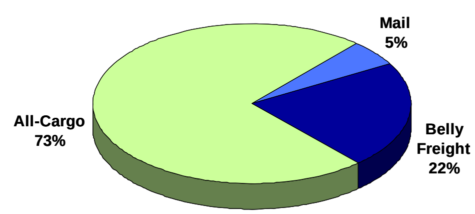
In addition to these specific trends that impacted the U.S. and Bay Area air cargo markets, economic activity is the principal driver of air cargo demand. A comparison of personal income growth for the Bay Area and the U.S. shows that the Bay Area economy was disproportionately impacted by the 2001 recession and the bursting of the dot com bubble. Bay Area personal income declined by 0.1 percent per year from 2000 to 2006, compared to average annual personal income growth of 1.8 percent for the total U.S. (See Exhibit 3-2) As a result, Bay Area cargo volume fell at a faster rate than U.S. air cargo.

3.1.2 Bay Area Cargo Market Segments

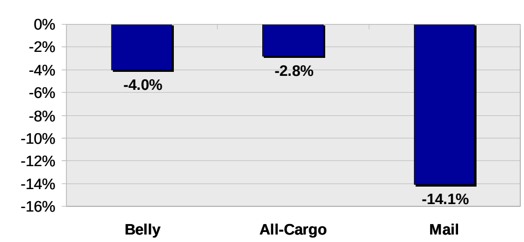
Air cargo can be divided into three separate market segments, each with distinct growth trends and implications for runway capacity. "All-Cargo", which refers to air freight transported in aircraft dedicated to carrying cargo, accounted for 73 percent of Bay Area air cargo in 2007. (See Exhibit 3-3) "Belly cargo", which refers to air freight that is transported by passenger airlines in the belly compartments of passenger aircraft, represented 22 percent of Bay Area air cargo. Mail, which can be transported in the bellies of passenger aircraft or in all-cargo aircraft, accounted for just 5 percent of Bay Area cargo.

Exhibit 3-3 – The Majority of Bay Area Air Cargo Moves in All-Cargo Aircraft

Bay Area Air Cargo by Type



Average Annual Growth by Type
(2000-2007)



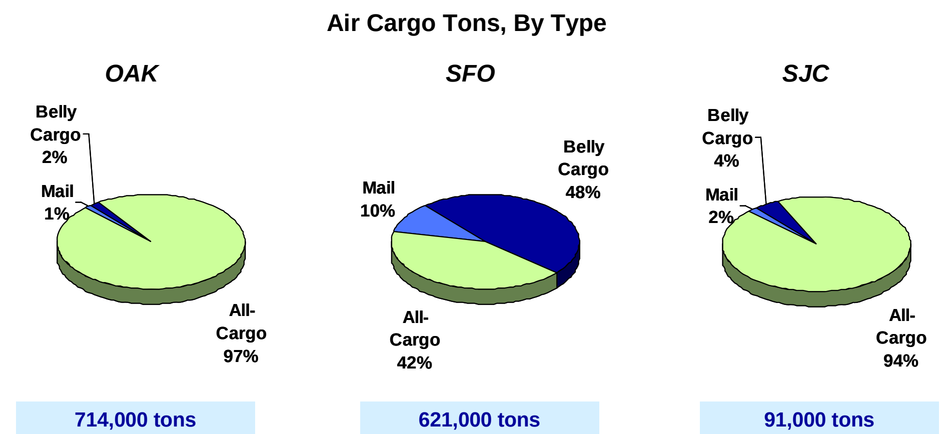
Source: T100 On-flight Database and Airport Statistical Reports.

Over the forecast period, only the portion of air cargo that is carried in dedicated "all-cargo" aircraft will translate into additional aircraft operations at the airports. However, all-cargo flights operate mainly during off-peak hours and hence do not contribute significantly to runway congestion.

Exhibit 3-3 also shows the relative growth rates for the three air cargo segments. From 2000 to 2007, all-cargo volume declined by 2.8 percent per year. Belly cargo declined at a faster rate of 4.0 percent as passenger airlines decreased their use of widebody aircraft in long-haul domestic services during this period. Mail showed the steepest decline, falling at an average annual rate of 14.1 percent. The comparatively sharp drop in mail is consistent with overall industry trends and is partially due to the increased substitution of e-mail and other electronic delivery means. In addition, there was an extreme drop in reported mail statistics in 2001 and 2002 which coincides with FedEx assuming the U.S. Postal Service contract for transporting mail. The drop in those years is partially due to FedEx's reporting practice of including the mail shipments in its freight statistics rather than reporting mail separately.

The composition of the air cargo market varies across the three Bay Area airports. At OAK, which serves as a regional hub for FedEx, the tons moving in all-cargo aircraft accounted for 97 percent of the airport's total air cargo tons in 2007. (See Exhibit 3-4). SFO, on the other hand, had a much lower all-cargo share at 42 percent. Because of its role as an international gateway and a higher level of widebody passenger aircraft services, nearly half of SFO's cargo was accommodated in the belly compartments of passenger aircraft.

Exhibit 3-4 – Composition of Air Cargo Market at the Bay Area Airports in 2007



Source: T100 On-flight Database and Airport Statistical Reports.

The composition of the cargo market at SJC is similar to OAK, with all-cargo aircraft accounting for 93 percent of the airport's cargo tons in 2007. However, the amount of air-cargo transported by all-cargo aircraft at SJC was much lower than the amount accommodated at OAK. In 2007, all-cargo aircraft at SJC carried 86,000 tons, compared to 695,000 tons enplaned or deplaned on all-cargo aircraft at OAK. The disparity is more a reflection of how airlines serve the cargo market than the amount of air cargo generated by the OAK and SJC market areas. With a larger cargo operation at OAK, the integrators, FedEx and UPS truck a significant amount of Bay Area cargo to and from the OAK facility.

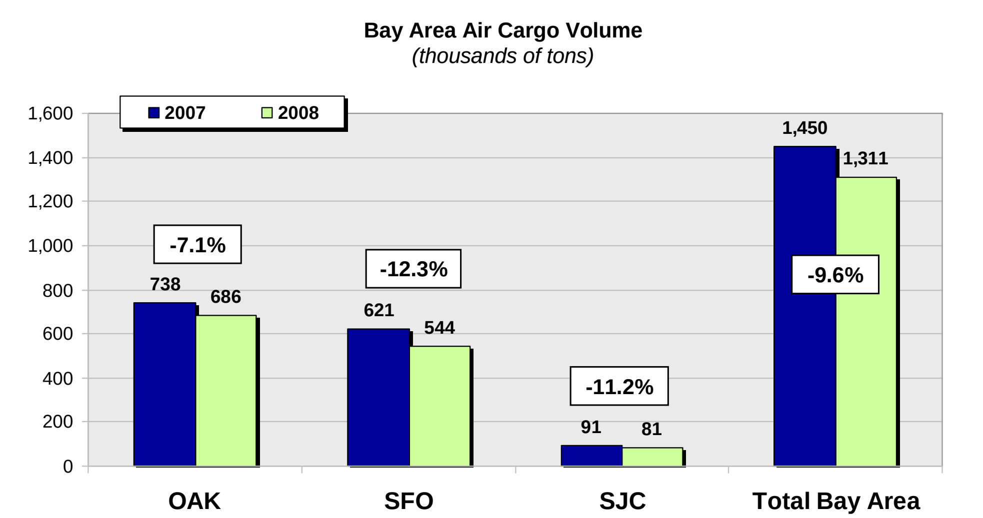
3.2 CARGO FORECAST APPROACH

Because of the distinct nature of air cargo at each of the Bay Area airports, a separate forecast was developed for each airport based on its specific mix of air cargo activity. The forecast approach reflects the near-term impact of the current economic recession on air cargo and relates long-term growth in air cargo to a consensus forecast of national air cargo trends.

3.2.1 Short-term Forecast Growth Assumptions

The current economic recession, which officially began in 4Q 2007 but worsened with the credit crisis in 3Q 2008, has had a negative impact on Bay Area air cargo volume. As shown in Exhibit 3-5, total air cargo at the primary Bay Area airports declined by nearly 10 percent in 2008. SFO, which recorded the steepest decline at 12 percent, saw declines in both domestic and international cargo. Total air cargo at OAK fell by 7 percent last year.

Exhibit 3-5 – Total Air Cargo in the Bay Area Fell by Nearly 10 Percent in 2008



Source: Airport Statistical Reports.

The recession has continued to deepen in 2009 as the national unemployment rate reached 8.9 percent in April and consumers have sharply reduced spending. Economists predict that the recovery from the recession will be slow and protracted, with growth resuming in the latter half of 2009, but unemployment remaining high throughout 2010. To reflect these economic conditions in the forecast of air cargo volume, no growth in air cargo volumes was assumed for the period, 2007 to 2011.

3.2.2 Long-term Forecast Growth Assumptions

Long-term growth assumptions for each segment of the Bay Area air cargo market were based on growth rates developed from the most recent available U.S. cargo market forecasts prepared by the FAA and Boeing, two relied upon sources for long-term cargo demand forecasts for the U.S. Since the FAA's FY2008-FY2025 Aerospace Forecast and Boeing's World Air Cargo Outlook were prepared before the economic recession worsened with the unfolding of the financial crisis in 3Q 2008, these forecasts were only used to develop growth rates for the 2011-2035 period. A separate growth assumption, as described above, was used for the near-term to reflect the current economic recession and anticipated recovery.

Exhibit 3-6 summarizes the Boeing and FAA long-term air cargo growth projections for the U.S. market. Boeing projects U.S. domestic revenue ton kilometers (RTKs) to increase at an average annual rate of 2.6 percent from 2007 to 2027. The FAA's long-range forecast for U.S. domestic revenue ton miles (RTMs) is slightly higher at 3.0 percent per year. According to the FAA forecast, RTMs for the all-cargo carriers are forecast to grow at 3.2 percent per year, faster than the 1.8 percent annual growth rate prediction for passenger carriers.

Both Boeing and the FAA forecast international air cargo to grow at a faster rate than domestic air cargo. Depending on the world region, Boeing forecasts U.S.-international air cargo to increase by 5.1 to 6.7 percent per year over the long-term. Similarly, the FAA projects international RTMS to grow at 6 percent annually, which is twice the FAA forecast rate for domestic RTMs.

Exhibit 3-6 – Boeing and FAA Long-Term Forecasts for U.S. Air Cargo Market

Market	Average Annual Growth Boeing RTKs 2007-2027	 FAA RTMs 2007-2025
Domestic	2.6%	3.0%
International		
Canada	5.6%	
Europe	5.1%	
Asia	6.7%	
Latin	5.7%	
Total		6.0%

RTKs – revenue ton kilometers; RTMs – revenue ton miles

Source: Boeing, World Cargo Forecast 2008-2009, Nov. 2008; FAA, Aerospace Forecasts, FY08-FY25, Mar. 2008.

Long-term forecast growth rates for the Bay Area cargo market segments – belly freight, all-cargo and mail – were developed from the Boeing and FAA forecasts and are summarized in Exhibit 3-7. Both the Boeing and FAA forecasts assume that future economic growth is the driver of forecast air cargo demand. For each growth scenario, the all-cargo segment is forecast to grow faster than belly cargo and international air cargo is forecast to grow faster than domestic air cargo. In the Base Case, Bay Area air cargo is forecast to grow at 0.75 times the consensus forecast for the U.S. air cargo market, based on the relationship between forecast real personal income growth for the Bay Area and the nation. Based on ABAG's 2007 Projections, total real personal income in the Bay Area is forecast to increase by 1.8 percent per year over the long-term forecast horizon (2007–2035), which is approximately 75 percent of the 2.5 percent average annual growth forecast for the U.S.[15]

Exhibit 3-7 – Long-term Growth Rate Assumptions for Bay Area Air Cargo

Growth Scenario	Average Annual Growth - 2011 to 2035 Dom Belly	Dom All-Cargo	Intl Belly	Intl All-Cargo
Base	1.6%	2.8%	5.3%	6.9%
High	1.6%	3.0%	6.1%	7.9%
Low	1.5%	2.6%	4.4%	5.8%

Note: International growth rate assumptions weighted by the Bay Area's mix of cargo by world region.
Source: SH&E.

[15] Forecast of U.S. real personal income growth based on projections prepared by NPA Data Services, September 2008.

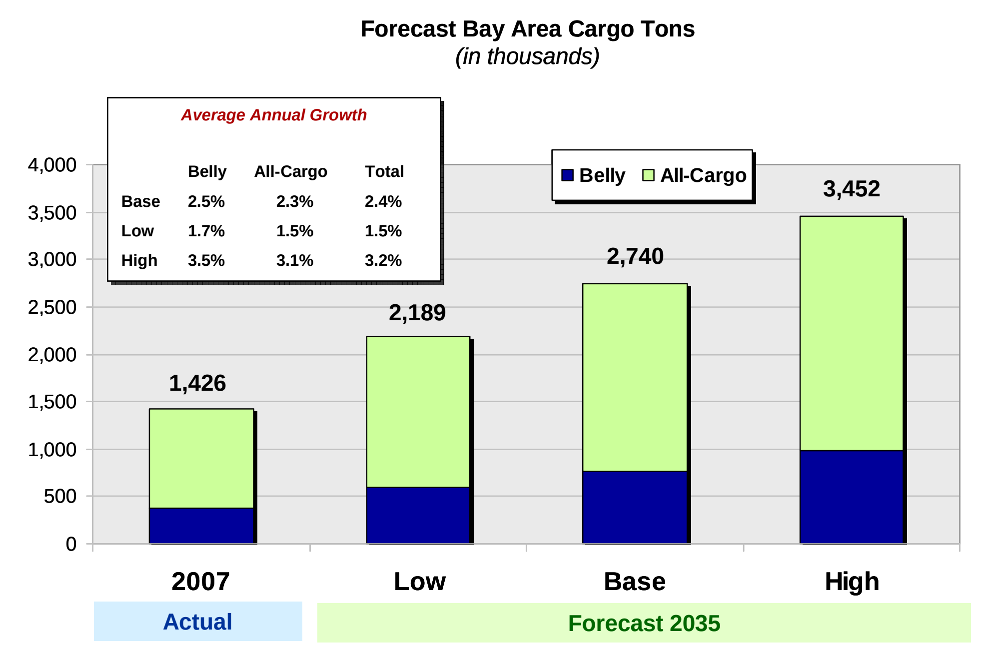
The Low Case assumes that Bay Area air cargo grows at 0.5 times the U.S. growth rate and in the High Case Bay Area cargo is forecast to grow at the same rate as the U.S. industry average.

3.3 Forecast Bay Area Air Cargo Volumes

Total air cargo for the Bay Area is forecast to increase by 2.4 percent per year reaching 2.7 million tons in the Base Case. (See Exhibit 3-8) Belly cargo is forecast to increase slightly faster at 2.5 percent annually. While domestic belly cargo is forecast to increase by only 1.6 percent per year, international belly cargo, which accounted for 57 percent of the region's belly cargo in 2007, is forecast to increase by 5.3 percent per year.

Total cargo is forecast to increase by 1.5 percent per year in the Low Case and by 3.2 percent in the High Case.

Exhibit 3-8 – Bay Area Air Cargo is Forecast to Grow at 1.5% to 3.2% per Year



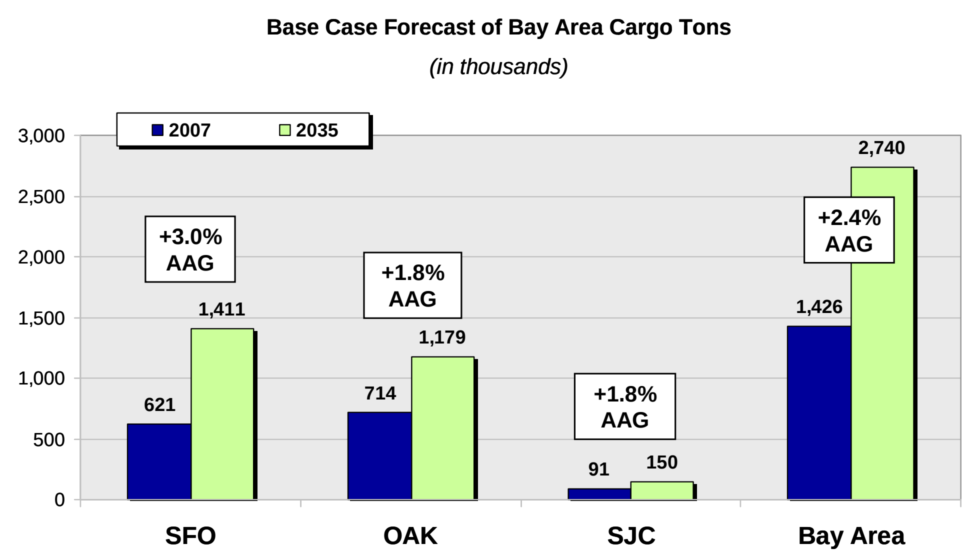
Note: Enplaned plus deplaned tons. Includes freight and mail for passenger airlines and all-cargo airlines.

Source: SH&E.

Exhibit 3-9 shows the Base Case cargo forecast by airport. SFO is forecast to experience the fastest growth with air cargo increasing by 3.0 percent per year and reaching 1.4 million tons in 2035. At OAK and SJC, air cargo is forecast to increase more slowly at 1.8 percent per year largely because the forecast assumes that long-haul international passenger services with available belly cargo capacity do not develop at OAK or SJC. At OAK, total cargo tons are forecast to increase from 714,000 in 2007 to nearly 1.2 million in 2035. Cargo tons at SJC are forecast at 153,000 tons in 2035, which is lower than the airport's peak level of 163,000 tons in 2000 when SJC was served with widebody aircraft to Asia.

The higher cargo growth forecast for SFO stems from its role as an international gateway airport and the assumption that international cargo, both belly cargo and cargo moving in all-cargo aircraft, will increase at a faster rate than domestic cargo, which is a more mature market. OAK and SJC have similar forecast growth rates because the mix of belly cargo, all-cargo and mail is similar for both airports.

Exhibit 3-9 – Air Cargo is Forecast to Grow the Fastest at SFO Because of its Role as an International Gateway Airport



Note: Enplaned plus deplaned tons. Includes freight and mail for passenger airlines and all-cargo airlines.

Source: SH&E.

See Appendix C for more detailed air cargo projections by airport.

3.4 FORECAST BENCHMARKING

Exhibit 3-10 compares the updated cargo forecast to the 2000 RASP forecast. Actual Bay Area air cargo tonnage in 2007 was 45 percent below the level forecast in the 2000 RASP. The 2000 RASP forecast was prepared before the 2001 recession, the terrorist attacks in 2001, the dot.com fallout, and the substitution of trucking and maritime for certain air cargo shipments, all of which depressed air cargo levels at the Bay Area airports.

The 2000 RASP forecast assumed a long-term average annual growth rate (through 2020) of 5.9 percent for Bay Area air cargo. The lower growth rate of 1.8 percent assumed in the updated cargo forecast for the period 2007 to 2020 reflects the impacts of high fuel prices in 2008 and the current state of the global economy.

Over the entire planning horizon (2007 to 2035), the updated forecast assumes that Bay Area air cargo increases by 2.4 percent per year. Under this assumption, total air cargo for the Bay Area airports reaches 2.7 million tons in 2035, or approximately half of the previous long-term projection of 5.5 million in 2020.

Exhibit 3-10 – The Long-term Air Cargo Forecast is Approximately 50 Percent Lower Than the 2000 RASP Forecast

	Air Cargo Tons (000s)			Average Annual Growth		
Airport / Forecast	2007	2020	2035	2007-2020	2020-2035	2007-2035
SFO						
Forecast Update	621 \1	833	1,411	2.3%	3.6%	3.0%
2000 RASP	1,302	2,978	na	6.6%	-	-
OAK						
Forecast Update	714 \1	862	1,179	1.5%	2.1%	1.8%
2000 RASP	1,101	2,069	na	5.0%	-	-
SJC						
Forecast Update	91 \1	110	150	1.4%	2.1%	1.8%
2000 RASP	203	418	na	5.7%	-	-
Total Bay Area						
Forecast Update	1,426 \1	1,805	2,740	1.8%	2.8%	2.4%
2000 RASP	2,606	5,465	na	5.9%	-	-

\1 Actual 2007 cargo tons.

Source: SH&E Forecast.

4 General Aviation Operations Forecast

4.1 Introduction

4.1.1 Overview

This section addresses the forecast of general aviation (GA) operations at the three air carrier airports serving the Bay Area – Oakland, San Francisco and San Jose. General aviation refers to all civilian aircraft operations other than those performed by commercial air carriers, and includes operations by private businesses and individuals, fractional jet operators, and air taxi providers, as well as pilot training activities. The types of aircraft typically used in GA operations vary from high performance business jet aircraft to single engine piston aircraft. Because GA aircraft use the runway facilities at the Bay Area airports, a forecast of future GA activity must be included in the assessment of aviation demand and capacity in the Bay Area.

There are two major segments of GA activity – itinerant and local. Itinerant operations, which include those that arrive from or depart to an airport beyond 20 nautical miles (nm) of the airport, are the most relevant to the capacity issue since a significant portion of these use the air carrier runways at the Bay Area airports. Local operations are conducted within a 20 nm radius of the airport and consist primarily of pilot-training activities. Local operations present less of a capacity issue because they are predominantly conducted on separate GA runways that are not used by commercial air carriers. This section primarily focuses on the forecast of itinerant operations and also presents a forecast of local GA and military operations.

4.2 Itinerant GA Operations

4.2.1 Itinerant Operations by Aircraft Category

There are two categories of itinerant general aviation activity that are distinguished by aircraft type – jet and non-jet. Each category is driven by different factors and, as a result, each has exhibited different growth trends.

- **GA jet operations** consist mainly of "business jet" aircraft with typical seating configurations ranging from 6 to 15 passengers. These aircraft are typically owned by corporations, wealthy individuals, or "fractional" aircraft

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operators. Since 2000, business jet operations have been growing at all three Bay Area airports as well as nationally, despite a significant drop in activity during the last half of 2008. Growth in GA jet operations is driven primarily by economic and technology changes, including factors such as business conditions, corporate profits, corporate and individual wealth, and new jet aircraft technology. Also, financial innovations, such as fractional aircraft ownership and new air taxi/ and corporate travel business models have stimulated GA jet activity over the past decade, as well as the increased desire to avoid commercial airline services to avoid delays and terminal access and waiting times.

- **GA "non-jet" operations** consist of small piston aircraft that are used mainly for personal or pleasure flying and small turboprop aircraft that are used for personal and business trips. Since 2000, non-jet operations have declined significantly at each of the Bay Area airports, as well as nationally. Because GA non-jet activity is largely related to personal and recreational flying, it is more sensitive to high fuel prices and aircraft ownership costs, which have been increasing, than GA jet operations that are primarily conducted for business use.

An important objective of the itinerant GA forecasts is to accurately identify the business jet and non-jet flight activity, and to properly project future activity for each market segment.[16] Because the three Bay Area airports are air carrier airports serving a major metropolitan area, business jet aircraft comprise a significantly higher proportion of itinerant GA activity than the average of all U.S. airports. As shown in Exhibit 4-1, in 2008, GA jet operations accounted for approximately 50 percent of itinerant GA operations at the three Bay Area airports, compared to 22 percent for the total U.S.

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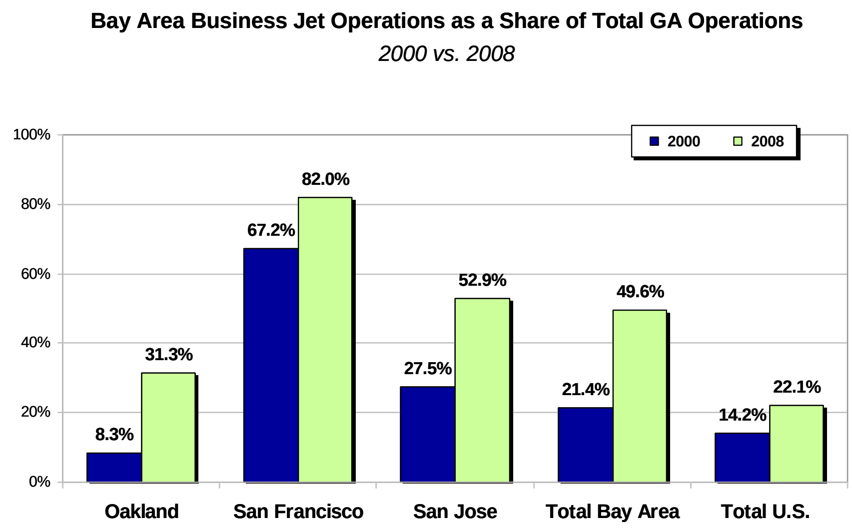
[16] It should be noted that the FAA databases, ATADS and Terminal Area Forecasts, which include historical and forecast general aviation activity by airport, do not separate GA operations by aircraft type or aircraft category.

Exhibit 4-1 – Jet Aircraft Account for Approximately 50 percent of Total GA Itinerant Operations at Bay Area Airports

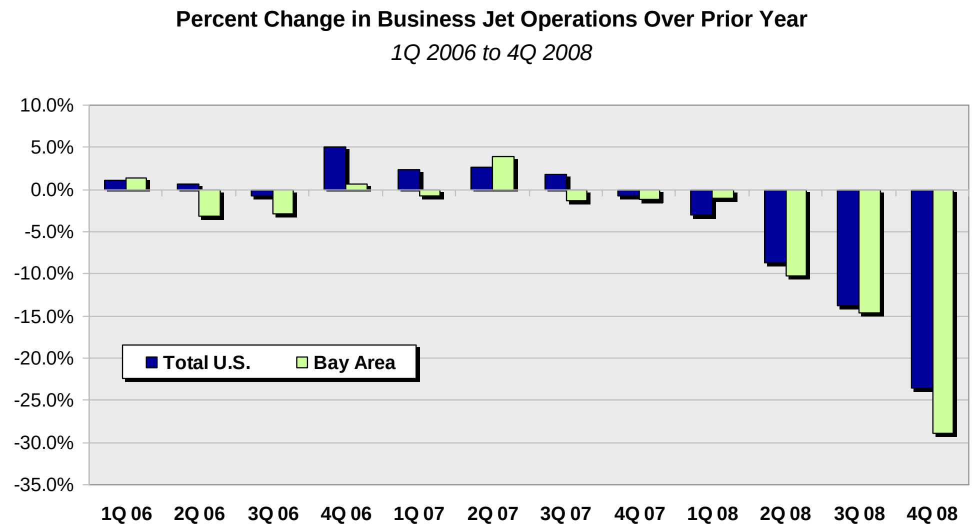


Sources: FAA ETMSC and ATADS databases (GA category adjusted to include business jet activity reported in other user group categories).

4.2.2 Recent Recession Related Impacts

After years of relatively strong growth, GA business jet activity in the U.S., as well as at the Bay Area airports, has been particularly hard hit by the current global recession, especially since the recession worsened with the unfolding of the credit crisis during 4Q 2008. As shown in Exhibit 4-2, GA jet operations in the U.S. began to decline sharply in 2Q 2008, and escalated to nearly a 25 percent decline in 4Q 2008. In the Bay Area, the decline in GA jet activity was slightly greater than the national average. Overall, Bay Area GA jet operations fell by 13.6 percent in 2008, compared to a 12.2 percent reduction nationally. The current recession has had, and is expected to continue to have, a significant adverse impact on business jet operations in the short term, as many companies have reduced private jet travel and aircraft manufacturers have scaled back business jet production. These factors are reflected in the short-term forecast assumptions.

Exhibit 4-2 – Itinerant GA Jet Operations in the Bay Area and the U.S. Declined Sharply in 2008 Due to the Recession



Source: FAA, ETMSC Database.

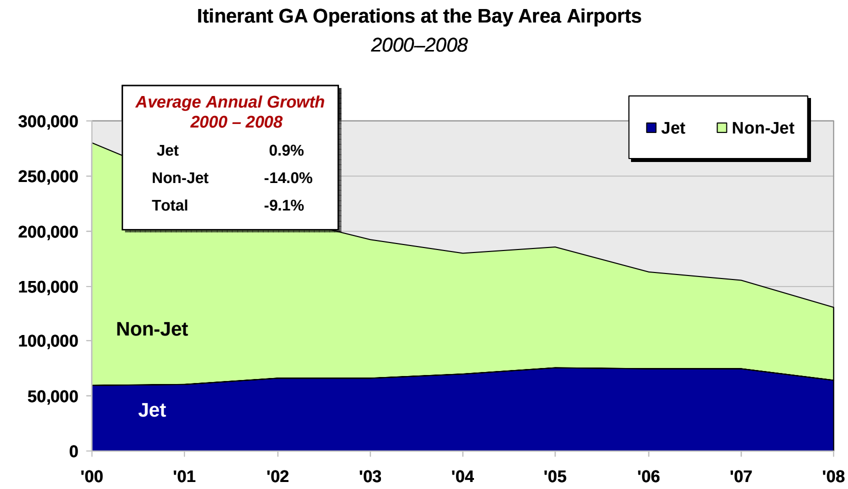
4.3 HISTORICAL TRENDS IN ITINERANT GA ACTIVITY

From 1990 to 2000, the total itinerant general aviation activity at the three primary Bay Area airports was relatively constant. GA operations declined by only 0.3 percent per year, which was approximately equal to rate of decline nationally. However, from 2000 to 2008, operations at the Bay Area airports declined by 9.1 percent per year, compared to a decline of 3.6 percent per year for the total U.S. market. (See Exhibit 4-3) The decline in Bay Area itinerant GA activity over this period was due entirely to a reduction in non-jet activity, as GA jet activity increased by 0.9 percent per year over the same period.[17]

[17] Excluding the impact of the current recession, Bay Area GA jet operations grew by 3.2 percent per year from 2000 to 2007.

Exhibit 4-3 – Since 2000, Bay Area GA Jet Operations have Grown Slightly, While GA Non-jet Operations have Declined Significantly

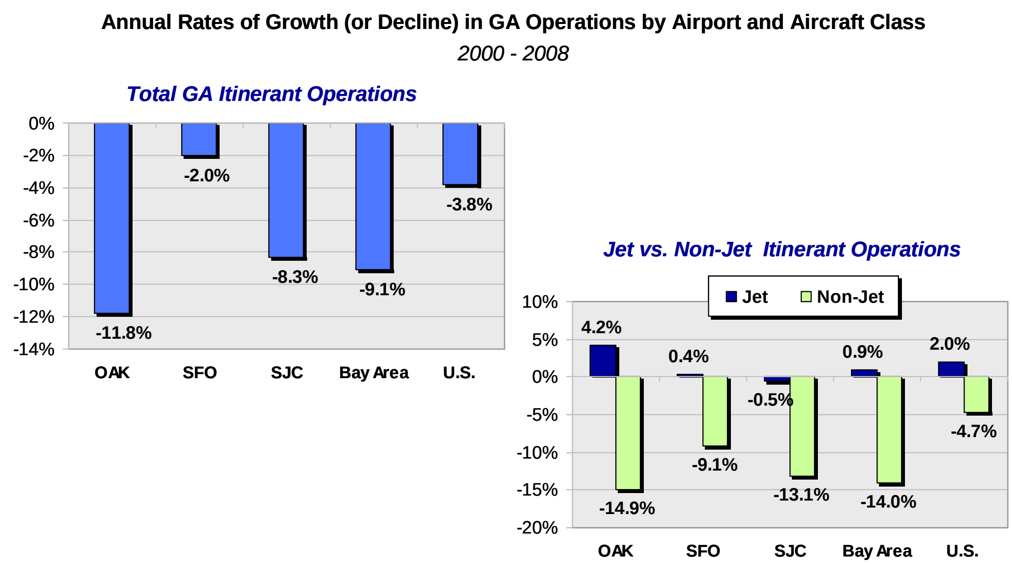
Note: Excludes local GA operations (mainly pilot training and flights that stay in local airspace).



Source: FAA ETMSC and ATADS Databases

As shown in Exhibit 4-4, GA jet operations nationally have increased at 2.0 percent per year since 2000, while GA non-jet activity has declined by 4.7 percent annually.

Exhibit 4-4 – Bay Area Business Jet Activity Grew More Slowly and Non-Jet Operations Declined More Rapidly than U.S. GA Activity



Source: FAA ETMSC and ATADS databases.

Exhibit 4-5 summarizes historic GA activity at each of the Bay Area airports in terms of average GA aircraft arrivals per day. In 2008, San Jose had the greatest number of jet operations at 34 per day, followed closely by San Francisco at 30 per day. Non-jet arrivals declined over the 2000-2008 period from 194 to 53 per day at Oakland, and from 94 to 30 per day at San Jose. The reduction in non-jet activity at OAK and SJC is partly due to the closure of flight schools and FBO operations and partially a result of the FAA's revised methods of estimating GA operations, which formerly overstated activity levels.

Exhibit 4-5 – Average Itinerant GA Aircraft Arrivals per Day at Bay Area Airports

Average GA Arrivals per Day

2000, 2007 and 2008

Year	Average GA Arrivals per Day OAK	SFO	SJC	Total
		Jet Arrivals		
2000	17	29	36	82
2007	25	38	39	103
2008	24	30	34	89
		Non-jet Arrivals		
2000	194	14	94	302
2007	67	9	34	110
2008	53	7	30	90
		Total GA Arrivals		
2000	211	44	129	384
2007	93	47	73	212
2008	77	37	65	179

Note: Average arrivals per day are equal to annual operations divided by 730.

Source: FAA ETMSC and ATADS databases.

4.4 ITINERANT GA FORECAST METHODOLOGY

The approach for forecasting itinerant GA operations for the Bay Area airports reflects the two distinctly different categories of aircraft used in general aviation – business jets and all other non-jet aircraft. The forecasts were prepared using FAA reported activity data for the three airports and for all U.S. airports to reflect national trends. Recent FAA forecasts of general aviation activity, as well as forecasts and outlook briefs of aircraft and engine manufacturers, were reviewed and used as appropriate to formulate assumptions for future industry rates of growth. The forecasts are generally consistent with FAA forecast assumptions and the long term outlook for GA activity growth. However, it should be noted that the FAA forecasts that were available at the time the Bay Area GA forecasts were prepared, were developed prior to the recent recession-related drop in GA activity, and assumed a significantly milder impact. The principal steps of the forecast methodology were:

Step 1 - Compile FAA Historic GA Operations Data: Using the FAA's Enhanced Traffic Management System Counts (ETMSC) database, a historical series of business jet operations for the 2000-2008 period[18] was compiled. The historic data includes all commonly known business jet aircraft types, regardless of the reported user group category.[19] Military operations and all regional jet aircraft (i.e., regional jets over 40 seats) were excluded even though some may have been used as corporate aircraft. For the historical series of non-jet GA, activity was as reported in the FAA database.

Step 2 - Analyze Historic Bay Area and U.S. GA Trends: The historical database of jet and non-jet activity developed in Step 1 was reviewed to determine GA growth trends at each of the Bay Area airports and corresponding national trends. (See Section 4.2 for a discussion of historic trends in GA activity.)

Step 3 - Review FAA General Aviation Forecasts and Other Industry Forecasts: The FAA publishes two forecasts annually that are relevant for general aviation activity. The first is the *Aerospace Forecast*, which provides national forecasts of commercial and general aviation activity and FAA workload metrics for an 18-year planning horizon. The *Aerospace Forecast Fiscal Years 2008 to 2025*, released in March 2008, was the most recent FAA forecast available at the time the GA forecasts were prepared. Although there are a number of different general aviation metrics that are covered by the *Aerospace Forecasts*, general aviation operations by user group and aircraft category are not explicitly included. However, other related activity measures, such as GA fleet by aircraft category, hours flown by aircraft category, and total GA operations are included and can be used to impute estimates of operations.

The FAA also publishes the *Terminal Area Forecast (TAF)*, which includes an operations forecast by user group for all U.S. airports in the FAA's National Plan of Integrated Airport System (NPIAS). The most recent TAF was published in December 2008. This forecast reflects a more recent assessment of the declining

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[18] Note, December 2008 data was estimated at the same year-over-year rate of change reported for November 2008.

[19] A significant portion of operations with business jet aircraft in FAA databases are included in "Air Carrier", "Air Taxi" and "Other" user group categories. These are flights that were conducted by commercial operators, such as on-demand charter companies and fractional business jet operators.

economy and assumes a more significant near-term decline in GA operations than the March 2008 Aerospace Forecast.

Nationally, the FAA TAF forecast shows a 7.4 percent decline in GA activity for FY 2008, a 1.1 decrease in FY 2009 and 0.5 percent reduction in FY 2010. From FY 2010 to FY 2025, the FAA TAF projects national GA operations to grow by approximately 1.4 percent per year.

For the Bay Area airports combined, the FAA TAF projects a 12.2 percent decline in FY 2008, a 2.1 percent drop in FY 2009 and a 0.9 percent reduction in 2010. Each of these decreases is slightly greater than the national average. Thereafter, the long term annual growth rate for the Bay Area airports averages 1.4 percent per year through 2025, or equal to the forecast national average growth rate. The TAF does not provide separate forecasts for GA jet and GA non-jet aircraft activity.

Step 4 - Adjust FAA Forecast for U.S. GA Operations to Reflect Current Economic Recession: In the latter part of 2008, the U.S. economic recession deepened and became far worse than what the FAA assumed in its March 2008 *Aerospace Forecasts*, with significant negative impacts on general aviation that are observable from actual activity available through the end of 2008. Therefore, it was necessary to adjust the FAA forecast growth rates for the short term planning horizon to specifically account for the decline in activity during the current economic crisis and the subsequent period of economic recovery.

With one notable exception, the assumptions and “normal” rates of growth projected by the FAA for later years beyond the recession/recovery period were generally adopted in the Bay Area GA activity forecast. The exception relates to the FAA’s assumption of extraordinary growth in VLJ (Very Light Jet) fleet and related activity resulting from the introduction and proliferation of on-demand air taxi services as an alternative air travel mode. The VLJ projections in the FAA forecasts were adjusted downward because the development of this new market segment has not materialized. Several on-demand air taxi operators shut down and Eclipse, a VLJ aircraft manufacturer, entered Chapter 11 bankruptcy in 2008. The FAA forecasts the total number of hours flown by business jet aircraft from 2010 to 2025 to increase by 6.1 percent per year. After the adjustment for the VLJs, total business operations in the U.S. are forecast to increase by 4.5 percent annually from 2010 to 2025.

Step 5 – Forecast Bay Area GA Activity at Rates that Reflect the Historical Relationships to National Growth Rates.: GA operations at the Bay Area airports were forecast by applying the historic relationship of Bay Area GA growth to national growth (as developed in Step 2) to the adjusted forecast of national GA activity (as developed in Step 4).

The specific assumptions made in connection with the forecast are discussed in the following section.

4.4.1 Key Forecast Assumptions for the Bay Area Itinerant General Aviation Forecast

Total U.S. Future Itinerant GA Activity Growth Trends

Total U.S. itinerant GA operations are assumed to continue to decline in 2009 at approximately the same rate as in 2008; a 12.5 percent decline for business jet operations and a 10 percent reduction in non-jet operations.

Business jet activity in the U.S. is projected to grow by 5.0 percent per year from 2010 to 2014. This assumes that the recovery of business jet activity in this economic cycle will be slower than the typical "rebound" during previous economic cycles. It is expected that "corporate wealth", as measured by stock prices, will recover to former peak levels, but at a slower pace than in past recessions and the recent negative public perception of corporate use of business jets will continue to have an impact on activity levels. From 2015 to 2025, U.S. business jet activity is assumed to grow at rates similar to those projected by the FAA, averaging 4.0 percent to 4.5 percent annually. For the last ten years of the forecast period, 2026 to 2035, growth is projected to slow, averaging 2.5 percent to 3.0 percent per year.

Non-jet operations in the U.S. are assumed to exhibit the same basic near term decline and recovery trends as the business jets, but future growth is assumed to be much lower, consistent with the FAA forecast assumptions. In 2010 and 2011, annual growth of 5 percent is assumed to reflect an increase in activity during the economic recovery. Growth is assumed to fall to 1.2 percent from 2012 to 2015. For the next ten years, 2015 to 2025, U.S. non-jet GA operations are projected to grow at 1.0 percent annually and by 0.5 percent per year for the remainder of the forecast period.

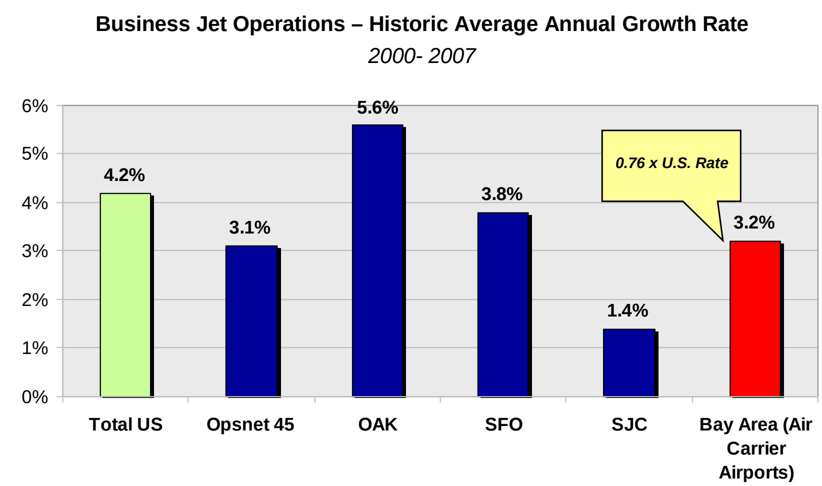
Bay Area Airports Future Itinerant GA Activity Growth Trends

In 2009, jet and non-jet GA operations at the Bay Area Airports are assumed to decline at approximately the same rates as they did in 2008, i.e., a 14 percent decline for jet operations and a 16 percent drop for non-jet operations.

For 2010 and subsequent forecast years, Bay Area GA activity is assumed to grow at 0.75 times the U.S. growth rate. This assumption was applied to all three airports and to both jet and non-jet activity, with one exception. Non-jet operations at SFO are assumed to grow at 0.5 times the corresponding U.S. growth rate. A lower growth factor was used for SFO because growth in non-jet operations is assumed to be inversely related to airport hub size. Non-jet operations are expected to grow the fastest at the nation's non-hub airports and the slowest at the large hub airport primarily because non-jet operators are more sensitive to costs than business jet operators and are less likely to operate at high cost large hub airports like SFO.

The 0.75 factor for future growth in Bay Area jet operations relative to the U.S. is based on actual growth in GA jet operations for the 2000-2007 period. The three Bay Area airports grew at 3.2 percent per year, compared to the national average growth rate of 4.2 percent for the same period. (See Exhibit 4-6) It should be noted that the Bay Area growth rate is approximately the same as other air carrier airports in large metropolitan areas. Although the growth rates differed by individual airport, there is insufficient trend data to conclude that these differences will continue over the next 25 years, and therefore it was assumed all three airports will grow at the same rate.

Exhibit 4-6 – Business Jet Operations at Bay Area Airports are Growing at Rates Comparable to Other Large Air Carrier Airports



Note: OPSNET 45 includes 45 major U.S. airports tracked by the FAA in its Operations Network database, the official source of FAA air traffic operations and delay data.

Source: FAA ETMSC and ATADS databases.

The 0.75 factor was also assumed for future growth in GA non-jet operations at OAK and SJC and 0.50 was assumed at SFO, notwithstanding the much lower ratio in the actual reported data. However, the historic data includes significant changes in the method of reporting operations, and the FAA's forecast growth rates for national GA non-jet operations are extremely low. Therefore, as a practical matter, the forecast of non-jet activity at the Bay Area airports in 2035 is only 3.4 percent greater than the reported 2008 operations.

Exhibit 4-7 summarizes the GA growth rate assumptions for the U.S. and the Bay Area Airports.

Exhibit 4-7 – Growth Assumptions for Itinerant GA Operations for the U.S. and for Bay Area Airports

Period		Forecast Average Annual Growth in GA Operations: Business Jets		Forecast Average Annual Growth in GA Operations: Non-Jets	
Forecast of Total U.S.					
2008-2009		-12.5%		-10.0%	
2009-2011		5.0%		5.0%	
2011-2014		5.0%		1.2%	
2014-2020		4.5%		1.0%	
2020-2025		4.0%		1.0%	
2025-2030		3.0%		0.5%	
2030-2035		2.5%		0.5%	
2009-2035		3.8%		1.1%	
Forecast of Bay Area Airports					
2008-2009	OAK	-10.0%		-20.0%	
	SFO	-15.0%		-20.0%	
	SJC	-15.0%		-10.0%	
	Total	-13.6%		-16.6%	
2009 - 2035	OAK	2.9%	\1	0.9%	\1
	SFO	2.9%	\1	0.6%	\2
	SJC	2.9%	\1	0.9%	\1
	Total	2.9%		0.8%	

Notes:
1/ Assumed at 0.75 times U.S. growth rate.
2/ Assumed at 0.5 times U.S. growth rate.

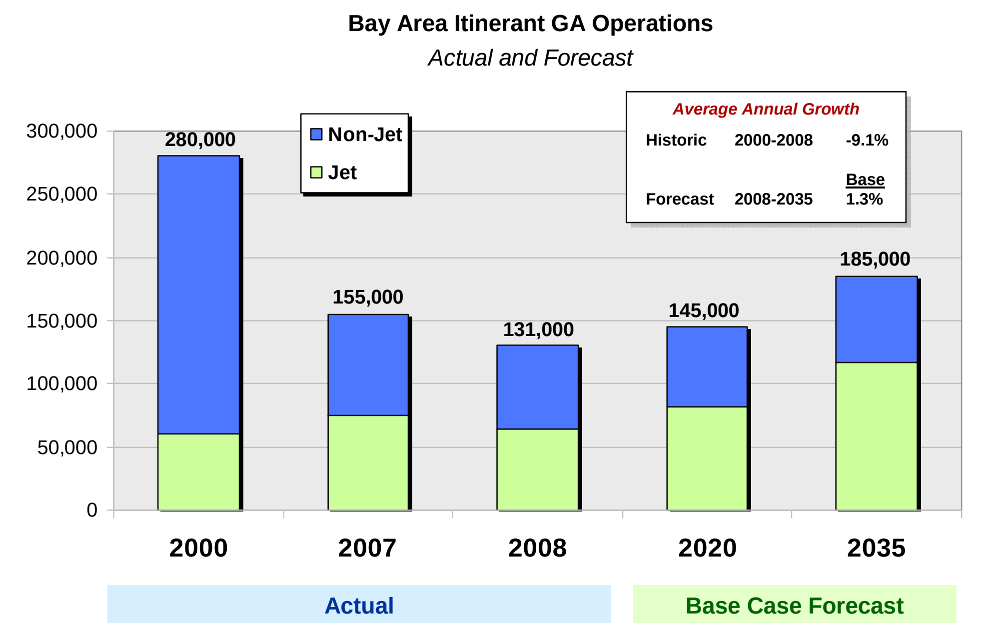
Source: SH&E Forecast.

4.5 Itinerant General Aviation Forecast

4.5.1 Base Case Forecast

Total itinerant GA operations at the three Bay Area airports are forecast to increase from 131,000 annual operations in 2008 to 185,000 operations in 2035. This represents an average growth rate of 1.3 percent per year over the entire period. Due to the recession-related decline in 2009, GA operations are projected to have net zero growth during the first 7 years of the forecast (2008-2015), and then increase at 2.1 percent annually from 2015 to 2025. For the last ten years of the forecast period, 2025-2035, growth tapers to 1.9 percent per year. As shown in Exhibit 4-8, GA operations are not forecast to return to the 2007 level until after 2020.

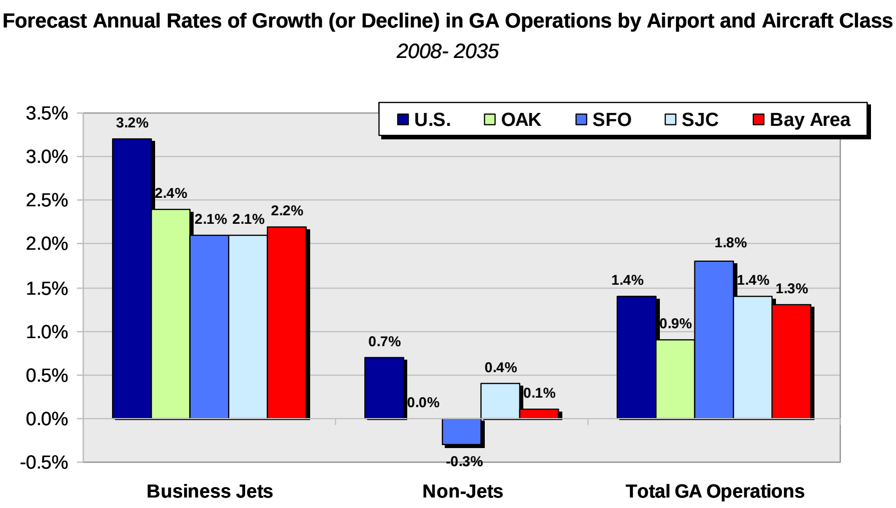
Exhibit 4-8 – Bay Area Airports Itinerant GA Operations are Forecast to Reach 185,000 in 2035



Source: SH&E Forecasts.

Business jet activity is projected to grow at the annual rate of 2.2 percent per year, as compared to non-jet operations growth of only 0.1 percent per year for the entire forecast period. (See Exhibit 4-9) Overall, San Francisco is forecast to have the highest rate of growth at 1.8 percent per year, compared to 0.9 percent and 1.4 percent per year for Oakland and San Jose, respectively.

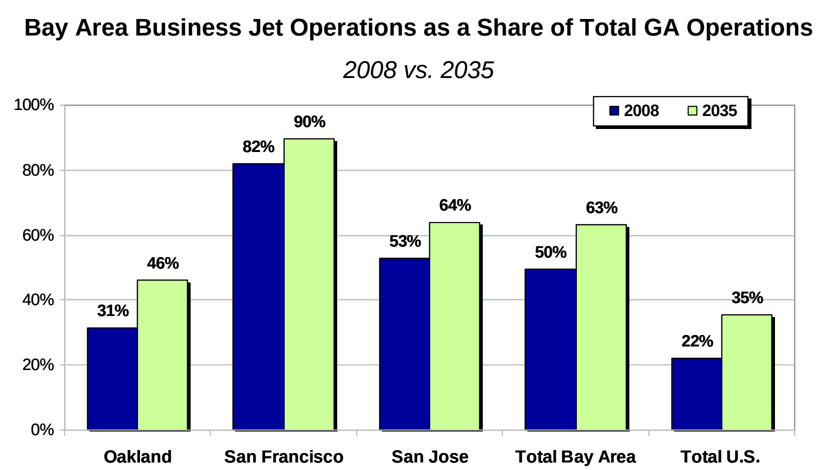
Exhibit 4-9 – Business Jet Operations at Bay Area Airports are Forecast to Increase by 2.2% per year Compared to 0.1% per year for Non-Jet Operations



Source: SH&E Forecast.

Business jet aircraft are forecast to account for the vast majority, or 96 percent, of the growth in GA operations over the planning period. The higher growth rate for San Francisco is due to the fact that jet aircraft currently account for more than 80 percent of SFO's GA activity, compared to 31 percent for Oakland and 53 percent for San Jose. (See Exhibit 4-10) Overall, the combined business jet share of GA activity at the Bay Area airports is projected to increase from 50 percent in 2008 to 63 percent in 2035. These business jet shares compare to a national average of 22 percent in 2008 and 35 percent in 2035.

Exhibit 4-10 – In 2035, Business Jets will Account for 63% of Bay Area Itinerant GA Operations



Source: SH&E Forecast

The current recession is forecast to have a significant impact on the Bay Area's general aviation activity. Business jet activity is forecast to decline by another 13.6 percent in 2009 and begin to recover with positive growth of 3.8 percent in 2010 and continuing at this rate through 2014. The result of this decline and recovery forecast is that the combined business jet operations is not expected to return to the 2007 level (75,000 operations) until sometime between 2017 and 2018. (See Exhibit 4-11)

Unlike business jets, non-jet GA activity at Bay Area airports has declined nearly every year since 2000, and experienced a 17.6 percent drop in 2008. A further 16.6 percent decline is forecast for 2009, followed by positive growth thereafter. However, much of the decrease in non-jet GA activity over the past decade is permanent. Non-jet activity levels are forecast to remain below the 2007 base year level (80,000) throughout the entire forecast period, reaching 68,000 annual operations in 2035.

Exhibit 4-11 – Summary of Bay Area Itinerant GA Forecasts by Airport, *Base Case*

	Oakland			San Francisco			San Jose			Total Bay Area Airports		
Year	Business Jet	Non-Jet	Total	Business Jet	Non-Jet	Total	Business Jet	Non-Jet	Total	Business Jet	Non-Jet	Total
Historic												
2000	12,730	141,439	154,169	21,415	10,433	31,848	25,928	68,272	94,200	60,073	220,144	280,217
2007	18,608	48,930	67,538	27,753	6,442	34,195	28,620	24,609	53,229	74,981	79,981	154,962
2008	17,661	38,846	56,507	22,152	4,852	27,005	24,959	22,242	47,201	64,772	65,940	130,713
Forecast												
2020	23,318	35,938	59,256	27,623	4,278	31,901	31,123	23,149	54,272	82,064	63,366	145,430
2035	33,154	38,729	71,882	39,275	4,497	43,772	44,251	24,947	69,198	116,679	68,173	184,853
AAGR												
2000-2008	4.2%	-14.9%	-11.8%	0.4%	-9.1%	-2.0%	-0.5%	-13.1%	-8.3%	0.9%	-14.0%	-9.1%
2008-2020	2.3%	-0.6%	0.4%	1.9%	-1.0%	1.4%	1.9%	0.3%	1.2%	2.0%	-0.3%	0.9%
2020-2035	2.4%	0.5%	1.3%	2.4%	0.3%	2.1%	2.4%	0.5%	1.6%	2.4%	0.5%	1.6%
2008-35	**2.4%**	**0.0%**	**0.9%**	**2.1%**	**-0.3%**	**1.8%**	**2.1%**	**0.4%**	**1.4%**	**2.2%**	**0.1%**	**1.3%**

Note:GA itinerant operations only; excludes local operations.

Source: FAA, ETMSC and ATADS databases and SH&E Forecast.

4.5.2 High and Low Case GA Operations Forecasts

A High and a Low Case for Bay Area GA activity were developed by varying the underlying assumptions in national GA activity trends. The Base Case growth rates for U.S. jet and non-jet activity were raised or lowered for the High and Low Cases, as follows:

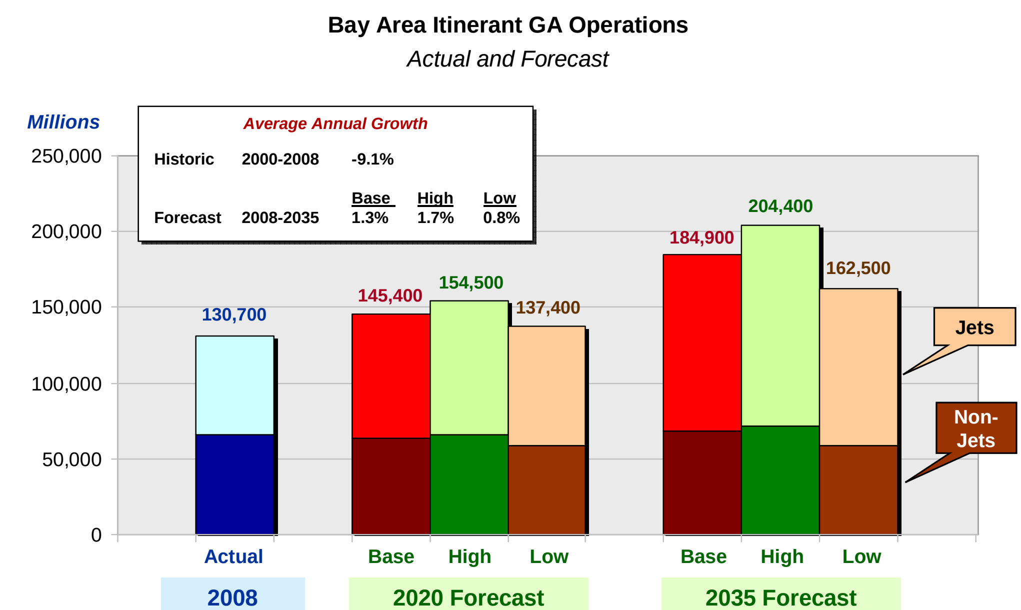
High Case: The High Case assumes a quicker recovery in business jet activity and higher long-term growth than the Base Case. To reflect these assumptions, the Base Case growth rate for U.S. GA jet operations was increased by 2.5 percentage points for 2012-2014 and by 0.5 percentage points for 2015-2035. The High Case also assumes that non-jet operations will grow slightly faster than in the Base Case. Accordingly, the national average growth rate for GA non-jet operations was increased by an average of 0.2 percentage points from 2012 through 2035.

Low Case: The Low Case assumes slower long-term growth in business jet and non-jet activity than the Base Case. To reflect these assumptions, the Base Case U.S. jet operations growth rate was reduced by 0.5 percentage points per year from 2012 to 2035. Similarly, the Base Case non-jet growth rate was reduced by 0.2 percentage points for the same period.

The High and Low Case GA forecasts retain the same assumptions regarding the relationship of the Bay Area's growth rates to national growth rates (as discussed in Section 4.4.1), with one exception. In the Low Case, non-jet operations are assumed to remain flat from 2012 through 2035. This assumption reflects the fact that the long-term historical trend in GA non-jet operations has been negative, but that such a trend would not likely continue indefinitely.

As shown in Exhibit 4-12, the forecast range for the Bay Area's GA operations in 2035 is 163,000 in the Low Case to 204,000 in the High Case. With all three forecast scenarios, business jets account for 63 percent of the total GA operations in 2035.

Exhibit 4-12 – Bay Area Itinerant GA Operations Forecast – High, Base and Low Cases



Source: SH&E Forecasts.

4.6 Forecast of Local General Aviation and Military Operations

Although local GA operations have limited impacts on capacity because they are exclusively conducted on GA runways at OAK and SJC and the level of local activity at SFO is almost negligible, a forecast of local GA operations was prepared to present a complete picture of future expected aircraft operations at the Bay Area Airports. Similarly, the level of military operations is insignificant, but was also included in the baseline forecasts. Exhibit 5-8 summarizes historic and forecast local GA and military operations under the base Case assumptions.

Exhibit 5-8 – Historic and Forecast Local GA and Military Operations at the Bay Area Airports, *Base Case*

	Local GA Operations				Military Operations			
Year	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Historic								
2000	108,260	1,329	51,128	160,717	452	2,179	199	2,830
2007	81,332	68	15,682	97,082	396	2,634	100	3,130
2008	46,031	134	15,477	61,642	1,910	2,697	206	4,813
Forecast								
2020	46,031	0	15,477	61,508	396	2,634	100	3,130
2035	49,971	0	16,769	66,740	396	2,634	100	3,130
Avg. Annual Growth								
2000-08	-10.1%	-24.9%	-13.9%	-11.3%	-	-	-	-
2008-20	0.0%	-	0.0%	0.0%	-	-	-	-
2020-35	0.5%	-	0.5%	0.5%	-	-	-	-
					-	-	-	-
2008-35	0.3%	-	0.3%	0.3%	-	-	-	-

Note: Military includes local and itinerant operations.

Source: FAA, ATADS database and SH&E Forecast.

At the Bay Area airports, local GA operations are heavily concentrated at OAK which accounted for over 80 percent of local GA operations in 2007. From 2000 to 2008, local GA operations declined sharply at each of the Bay Area airports, as well as nationally.

For the 2020 Base Case, local GA operations are forecast to remain at the levels experienced in 2008. This assumption recognizes the extraordinary drop in local GA operations at Oakland in 2008, which was over 40 percent. From 2020 to 2035, local GA operations are forecast to increase at the same low rate of growth as non-jet itinerant GA activity. The negligible base year local GA activity at SFO was assumed to disappear entirely. By 2035, nearly 67,000 local GA operations have forecast to occur at the Oak and SJC airports.

Military operations (itinerant and local) are assumed to remain constant at the 2007[20] levels throughout the forecast period, as is customary in forecasting the unpredictable needs and operations of the U.S. Department of Defense. (This same assumption applies for military operations in the Low and High Cases.) Military operations at Oakland and San Jose are insignificant, and at SFO military operations average approximately seven operations per day.

Forecasts of local GA operations for the Low and High Cases are based on two assumptions. For the first forecast year, 2020, local GA operations equal the Base Case operations times the ratio of the High (or Low) Case to the Base Case for non-jet itinerant operations. From 2020 to 2035, local GA operations are assumed to grow as the same rate as non-jet itinerant operations in the High and Low Cases, respectively. See Appendix D for the Base, Low and High forecasts of local GA and military operations.

[20] 2007 levels were chosen instead of 2008 because of the unusual spike in military activity at OAK in 2008. From 2000 to 2007 there was an average of 514 military operations per year.

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5 AIRCRAFT OPERATIONS AND FLEET MIX FORECAST

5.1 OVERVIEW AND FORECAST APPROACH

This section presents the forecast level and mix of operations by aircraft categories at each of the Bay Area Airports. Forecasts of the number of aircraft operations and the aircraft types (i.e., “fleet mix”) are the principal inputs to the runway capacity and delay modeling that will determine:

1. Whether OAK, SFO and SJC can accommodate the unconstrained forecasts of aircraft operations for 2020 and 2035; and
2. The runway capacity limits at each of the airports, and when these limits might be reached.

The number of hourly aircraft operations that can be handles at each of the airports is dependent on the mix of aircraft using the runway systems.[21] In addition, the forecast of operations and fleet mix is the principal input to the analysis of future baseline environmental impacts such as noise and air quality emissions.

The forecasts were prepared separately for each of the major user group categories, i.e., commercial passenger aircraft operations, all-cargo aircraft operations, general aviation and military operations.

5.1.1 Commercial Passenger and All-Cargo Aircraft Operations

The major steps involved in forecasting commercial passenger and all-cargo aircraft operations were:

Step 1 – Compile Base year 2007 Aircraft Operations Data: The base year 2007 traffic and flight data for passenger and all-cargo airlines were compiled from U.S. DOT data sources, mainly the T-100 database, which reports flight operations by aircraft type and route and includes on-board passenger, cargo and load factor

[21] Aircraft separation requirements vary based on the mix and sequencing of arriving and departing flights by aircraft size category.

statistics. Individual aircraft types were grouped into aircraft size categories, i.e., large widebody, small widebody, large narrowbody, etc.

Step 2 – Project Aircraft Capacity Requirements for 2020 and 2035: The 2020 and 2035 forecasts of seat capacity (and payload capacity for all-cargo operations) were derived from the passenger and cargo volume forecasts and assumptions regarding future load factors. For example, the forecast of 33.2 million domestic passengers at SFO in 2020 and a load factor assumption of 79 percent imply that the aircraft fleet serving those passengers must provide a total of 42.0 million seats. The capacity forecasts were prepared with similar regional detail as the traffic forecasts (i.e., domestic, international and transborder markets).

Step 3 – Determine Future Aircraft Fleet Mix: In this step the mix of aircraft providing the required future seat capacity (or payload capacity for all-cargo airlines) was determined. The forecast fleet mix was largely projected using future forecast fleet mix planning assumptions provided by each of the three Bay Area airports. The fleet mix assumptions were from the following airport planning documents:

- **Oakland**: Landrum & Brown *(Ultimate Future Schedule, 750 Daily Passenger Aircraft Operations)*
- **San Francisco**: Jacobs Consultancy *(2026 Design Day Schedules)*
- **San Jose**: Norman Y. Mineta San Jose International Airport. Airport Master Plan, July 2006 *(2017 Average Daily Aircraft Operations by INM Type)*

The distribution of capacity by aircraft type for 2020 was directly based on the fleet mix assumptions provided by each of the airports. Although the timing and the magnitude of the traffic forecasts in the individual airport planning studies differ from the updated RASP forecasts presented in this report, the future fleet mixes were scaled to the RASP traffic and capacity (i.e., seat or payload requirements) forecasts.

For the 2035 forecast, adjustments were made to the 2020 fleet mix to remove aircraft types that would be obsolete in 2035. The types that would be obsolete by 2035 were replaced with new generation aircraft of the same size category[22] (e.g., new generation 737-700s replaced older generation 737-300s, 787s replaced 767s, etc.). The forecast also assumes that a portion of SFO's B-747 capacity would be

[22] In some cases, the newer generation models have higher seat capacities than the older models. For example, the B737-300s in use at SFO had an average seat capacity of 126 in 2007 and are replaced by 2035 with a combination of B737-700/800/900s that have an average seat capacity of 145.

replaced by A-380s, consistent with airline aircraft orders and with other long range industry forecasts.

Thus, the forecasts of commercial passenger and all-cargo aircraft operations reflect the general future changes in aircraft size and aircraft types as presently projected in planning reports for each of the Bay Area airports. One significant exception is that the San Jose Master Plan provided for continued growth in long haul widebody international operations, whereas, these types of services, which were discontinued at the end of 2006 when SJC lost its Narita service, are not projected to resume in the current RASP forecasts.

Step 4 – Forecast the Number of Future Aircraft Operations: In the last step, the number of aircraft operations were determined by dividing the required future seat capacity for each aircraft type with the average capacity for that aircraft type. For example, if Step 3 determined that airlines would provide 4.8 million seats with Boeing 767 aircraft at SFO in 2020, the associated number of aircraft operations is 21,000 (i.e., 4.8 million seats divided by an average B-767 seating capacity of 224).

5.1.2 General Aviation Aircraft Operations

The number of general aviation operations at each of the three airports was forecast as described in Section 4. The base year 2007 distribution of GA operations by aircraft category was compiled from FAA databases. Assumptions regarding future changes in the mix of GA jet and non-jet aircraft by size category were derived primarily from FAA forecasts for the total U.S.

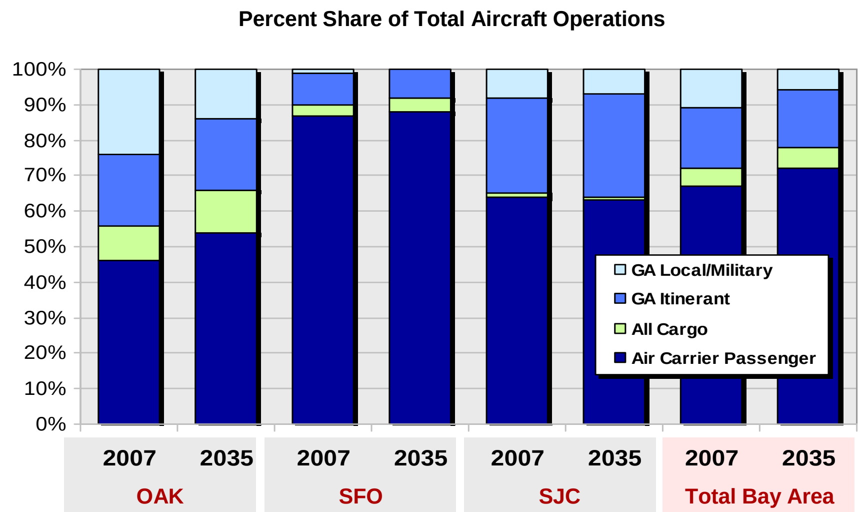
5.2 Base Case Forecast of Bay Area Aircraft Operations

5.2.1 Total Aircraft Operations

The total aircraft operations for all user groups at the three Bay Area airports are projected to increase from 910,000 in 2007 to 1,124,000 in 2035, an increase of 23.5 percent, or an average of 0.8 percent per year. Commercial passenger aircraft operations, which accounted for 67 percent of Bay Area operations in 2007, are forecast to grow at an average annual rate of 1.0 percent, while all-cargo aircraft operations are forecast to increase by 1.2 percent per year. For general aviation, itinerant operations are expected to increase by 0.6 percent per year, and local operations (including military operations) are projected to decline at the rate of 1.3 percent per year. As a result, the passenger aircraft share of total activity increases over the forecast period from 67 percent in 2007 to 72 percent in 2035. Over the same period, GA local operations are forecast to decline from 11 percent to 6 percent of total aircraft operations.

As shown in Exhibit 5-1, the most significant change in the distribution of operations among user groups is forecast at Oakland, where the commercial passenger and all-cargo aircraft share increases from 56 percent to 66 percent and the local GA operations share falls from 24 percent to 14 percent. The significant differences in the roles of the three airports are also notable in Exhibit 5.1. At SFO, airline operations (passenger and cargo) are forecast to account for 92 percent of operations in 2035, up slightly from 90 percent in 2007. By comparison, airline operations will account for approximately 65 percent of aircraft operations at both OAK and SJC in 2035.

Exhibit 5.1 – Passenger and Cargo Airline Operations will Account for an Increasing Share of Airport Operations Over the Forecast Period



Note: Includes total airport operations regardless of runway used.

Over the forecast period, air carrier and general aviation jet aircraft operations are forecast to grow faster than non-jet GA operations, at 1.1 percent per year, and will account for 88.4 percent of the total operations at the Bay Area airports in 2035. Exhibit 5-2 summarizes the overall operations forecast at each of the three airports and a more detailed summary is contained in Appendix E.

Exhibit 5-2 – Forecasts of Total Aircraft Operations at Bay Area Airports, 2007-2035

Category	Oakland			San Francisco			San Jose		
	2007	2020	2035	2007	2020	2035	2007	2020	2035
Air Carrier Passenger	155,900	161,100	192,600	326,200	384,600	461,200	127,800	129,500	153,000
All-Cargo	32,200	34,300	40,500	9,800	12,000	19,000	3,000	3,200	3,700
Subtotal Air Carrier	188,100	195,400	233,100	336,000	396,600	480,200	130,800	132,700	156,700
GA - Jets	18,600	23,300	33,200	27,800	27,600	39,300	28,600	31,100	44,300
GA - Nonjets	48,900	35,900	38,700	6,400	4,300	4,500	24,600	23,100	24,900
Total GA (Itinerant)	67,500	59,200	71,900	34,200	31,900	43,800	53,200	54,200	69,200
Subtotal Above	**255,600**	**254,600**	**305,000**	**370,200**	**428,500**	**524,000**	**184,000**	**186,900**	**225,900**
Military (total)	400	400	400	2,700	2,700	2,700	100	100	100
GA - Local Ops	81,300	46,000	49,600	100	-	-	15,700	15,500	16,700
Subtotal Local & Military	81,700	46,400	50,000	2,800	2,700	2,700	15,800	15,600	16,800
Total All Operations	**337,300**	**301,000**	**355,000**	**373,000**	**431,200**	**526,700**	**199,800**	**202,500**	**242,700**

5.2.2 Commercial Passenger Aircraft Operations

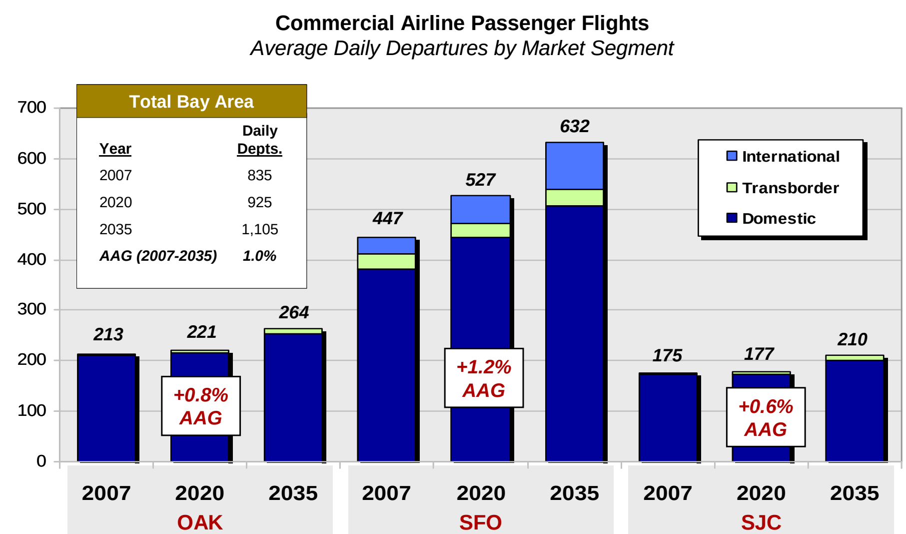
Exhibit 5-3 summarizes the commercial passenger aircraft operations forecast for each of the Bay Area Airports in terms of average daily departures[23]. Over 50 percent of the Bay Area's total commercial passenger aircraft flights take place at SFO, and SFO's share is forecast to increase over the forecast period. SFO's average daily departures are projected to increase by 1.2 percent per year from 447 in 2007 to 632 in 2035, which is significantly faster that than the 0.8 percent and 0.6 percent growth rate forecasts for Oakland and San Jose, respectively.

There are several reasons why commercial passenger aircraft operations are expected to grow faster at SFO than the other Bay Area airports. First, SFO has experienced a dramatic increase in domestic traffic and flights as a result of the recent expansion of Low Cost Carriers (LCC), which has shifted a portion of passenger and flight activity from OAK and SJC to SFO. With LCCs now serving all three airports, greater fare

[23] Average daily departures are calculated by dividing annual operations by 730.

parity among the three Bay Area airports is expected over the forecast horizon, which will contribute to faster growth in commercial passenger aircraft operations at SFO. Also, SFO is assumed to be the only Bay Area airport that serves as an international long-haul (i.e., transpacific or transatlantic) gateway, and international traffic is projected to grow faster than domestic traffic. Finally, SFO's domestic and international flights operate at significantly higher load factors than flights at Oakland and San Jose. As shown in Exhibit 5-4, the 2007 average domestic load factor at SFO was 79 percent, compared to approximately 71 percent at both OAK and SJC. With high load factors, future traffic growth at SFO is more likely to be accommodated with an increase in aircraft operations than an increase in load factors, whereas a significant portion of the passenger growth at OAK and SJC between 2007 and 2020 can be accommodated through an increase in load factors rather than an increase in aircraft operations. In addition to rising load factors, some of SFO's growth in passenger demand is accommodated by larger capacity aircraft as seen in the average passenger aircraft size, which increases from 137 in the base year to 173 in 2035.

Exhibit 5-3 – Commercial Airline Passenger Flights are Forecast to Increase the



Fastest at SFO

Note: AAG – average annual growth

Oakland's average daily flights are forecast to increase from 214 in 2007 to 264 in 2035. At San Jose, average daily aircraft departures increase from 175 to 210 over the forecast period exceeding the airport's 2000 peak-year average of approximately 207 daily departures. The domestic market is expected to remain the dominant market segment at both airports, with international flights serving the transborder markets (i.e., Canada and Mexico) accounting for up to 5 percent of total flights. For both airports, the increase in daily flights from 2007 to 2020 is negligible. This reflects the steep decline in flights at both airports in 2008, the relatively low projected rates of traffic growth through 2020, and the assumption that load factors will increase over this period. At SJC, a projected increase in the average aircraft seats per aircraft departure, from 118 to 134, further dampens future growth in aircraft operations.

Exhibit 5-4 – Summary of Passenger Airline Operations Forecast for the Bay Area Airports, *Base Case*

	Oakland			San Francisco			San Jose			Total Bay Area		
Statistic	2007	2020	2035	2007	2020	2035	2007	2020	2035	2007	2020	2035
Passengers (millions)	14.6	16.3	20.7	35.3	46.1	64.3	10.7	12.9	16.3	60.6	75.3	101.3
Seats (millions)	20.7	22.1	26.5	44.5	57.8	79.6	15.1	17.4	20.9	80.3	97.2	126.9
Load Factor	70.7%	74.0%	78.1%	79.3%	79.8%	80.9%	70.7%	74.0%	78.1%	75.5%	77.5%	79.8%
Operations	155,855	161,079	192,640	326,230	384,578	461,163	127,763	129,540	153,040	609,848	675,197	806,843
Departures per Day	214	221	264	447	527	632	175	177	210	835	925	1,105
Seats per Flight	133	137	137	137	150	173	118	134	137	132	144	157
Psgrs per Flight	94	101	107	108	120	140	83	99	107	99	112	126

Note: San Francisco's statistics reflect an increasing percentage of international traffic and services over the forecast period.

Source: SH&E forecast.

Passenger Airline Fleet Mix by Aircraft Class

Exhibit 5-5 illustrates the passenger airline fleet mix by aircraft class for each of the Bay Area airports. For all of the airports, the share of operations by regional aircraft (i.e., regional jets and turboprops) is forecast to decline over the forecast period, while narrowbody aircraft shares are forecast to increase.

At SFO, widebodies will also represent a growing share of total aircraft operations. Widebody departures at SFO are projected to more than double over the forecast period, from 66 to 136 daily departures, and account for 21.6 percent of SFO's total commercial passenger aircraft flights. Narrowbody flights are projected to increase by 63 percent while regional aircraft operations will decrease by 35 percent.

At Oakland, which is currently served exclusively with narrowbody and regional jets, the regional jet share will decline slightly. At San Jose, narrowbody operations, which accounted for 73.5 percent of commercial passenger aircraft operations in 2007, will increase to 88.6 percent and regional aircraft operations will fall from approximately 24 percent to 11 percent. By 2035, there will be no turboprop operations at SJC.

Exhibit 5-5 – Narrowbodies are Forecast to Represent a Growing Share of Commercial Passenger Flights at Each of the Bay Area Airports

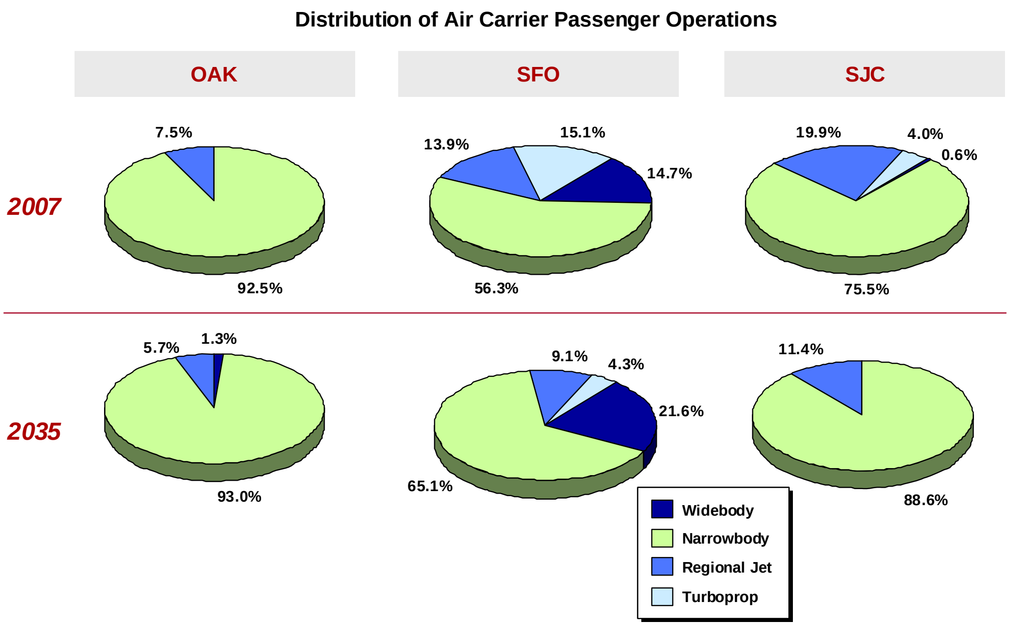


Exhibit 5-6 shows base year and forecast passenger airline operations by aircraft type for the Base Case. Over the forecast period, the number of operations by small regional aircraft (i.e., RJs and turboprops) declines sharply at SFO (down 35 percent) and SJC (down 44 percent), but remains constant at OAK. While the number of small aircraft operations declines over the forecast period, the average seat size increases as larger RJ and turboprops are introduced into airline fleets. At SFO, the number of widebody aircraft operations more than doubles as a result of growth in international passenger demand.

Exhibit 5-6 – Base Year and Forecast Passenger Airline Operations by Airport and Aircraft Type

Aircraft Category/ Type	Oakland		San Francisco		San Jose	
	2007	2035	2007	2035	2007	2035
767 (all)	-	-	17,424	-	730	-
787-9	-	-	-	35,523	-	-
777 (all)	-	-	12,284	26,035	-	-
A-330/340	-	-	3,171	3,075	-	-
747 (all)	-	-	15,064	27,532	-	-
A-380	-	-	-	7,377	-	-
Widebody Total	-	-	47,943	99,543	730	-
757 (all)	1,822	-	42,834	-	3,273	-
737-300	47,736	-	16,741	-	28,802	-
737-400/500	6,448	-	14,536	-	3,550	-
737-700/800/900	65,762	152,645	23,859	139,402	34,813	78,044
A-318/319/320/321	16,699	26,426	70,429	160,657	14,454	58,056
MD-80 (all)	5,688	-	15,246	-	11,632	-
Narrowbody Total	144,154	179,071	183,646	300,059	96,526	136,101
RJs (all)	11,701	11,056	45,272	41,901	25,413	16,940
Turboprops (all)	-	-	49,369	19,660	5,095	-
Regional Aircraft Total	11,701	11,056	94,641	61,561	30,507	16,940
Psgr Carrier Total	155,855	190,127	326,230	461,163	127,763	153,040

5.2.3 All-Cargo Operations

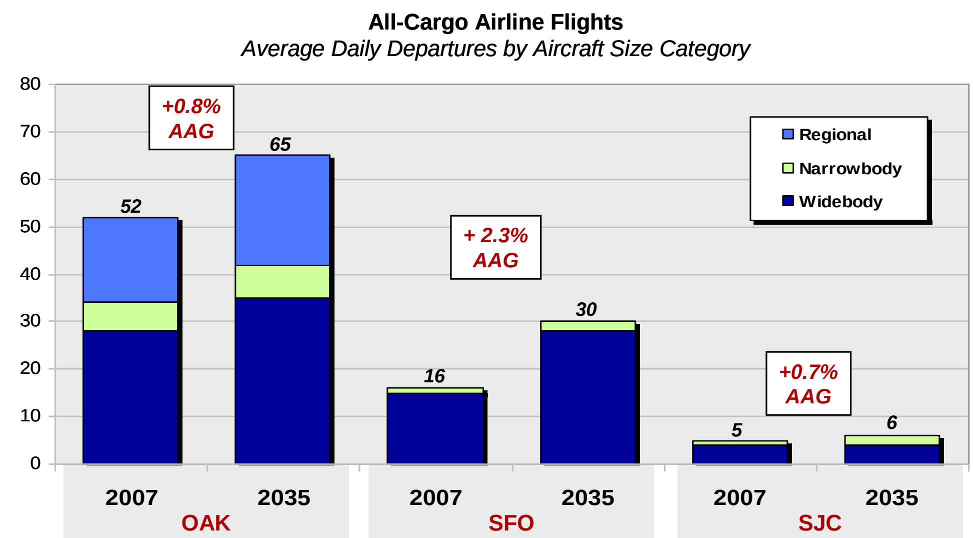
Among the three Bay Area airports, Oakland has the greatest number and the most diverse mix of all-cargo aircraft types because of the FedEx regional hub operation there. In 2007, Oakland had an average of 52 all-cargo departures per day[24] of which 28, or just over one-half, were operated with widebody aircraft. However, about one-third of the all-cargo operations at OAK were feeder flights operated with small

[24] Based on a customary 6-day operating week for all-cargo carriers.

regional aircraft. The non-jet cargo flights frequently use the shorter runway on OAK's North Field, while the larger all-cargo jets primarily use the longer, air carrier runways on South Field. At SFO, there were 16 daily all-cargo operations in 2007, 15 of which were operated with widebody aircraft. SFO's all-cargo flights are primarily transpacific flights, although some flights have domestic segments behind SFO that serve other U.S. points. San Jose's all-cargo service is primarily domestic and averaged five daily departures in 2007, four of which were operated with widebody aircraft.

Since the transpacific segment of the air cargo market is forecast to grow the fastest and considerably faster than the more mature domestic cargo market, SFO's all-cargo operations are projected to grow significantly faster rate than all-cargo operations at Oakland and San Jose. Over the entire forecast period, SFO's all-cargo operations are forecast to nearly double, compared to growth of 20 and 25 percent at OAK and SJC, respectively. The mix of all-cargo flights by aircraft category at each of the Bay Area airports is not expected to change materially during the forecast period.

Exhibit 5-7 – SFO is Forecast to Have the Highest Rate of Growth in All-Cargo Operations Among the Bay Area Airports



Note: AAG – average annual growth
Daily departures based on a 6-day week.

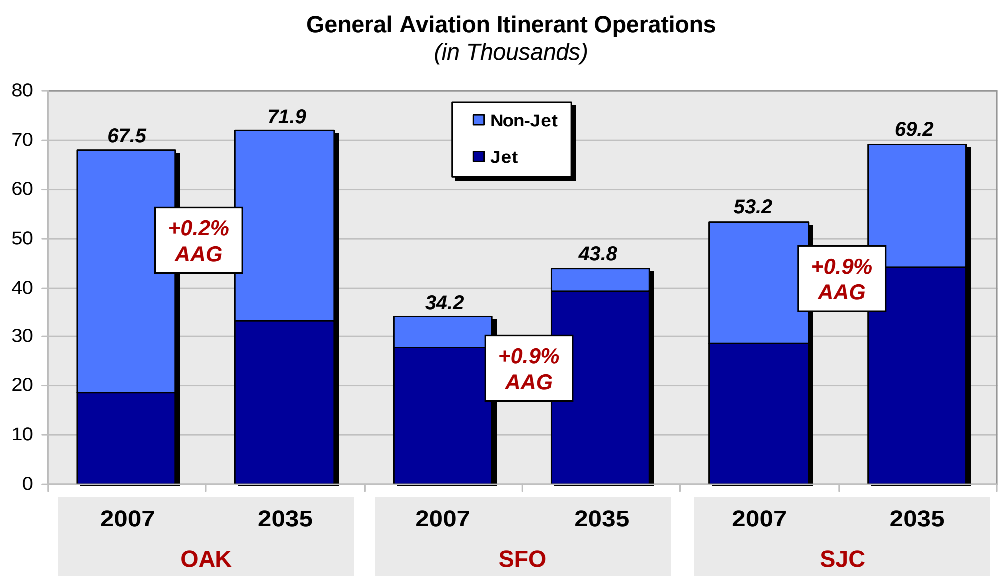
5.2.4 General Aviation Operations

The forecasts of itinerant and local GA operations and the mix between jet and non-jet operations are presented in detail in Chapter 4 and are briefly summarized in this section.

Exhibit 5-8 shows the forecast of itinerant GA operations. From 2007 to 2035, total itinerant GA operations are forecast to increase by 0.9 percent per year at SFO and San Jose, and by 0.2 percent per year at Oakland. The growth in GA operations at all three Bay Area airports is driven by the growth of business jet operations. For the entire forecast period, itinerant GA jet operations are projected to increase by 2.0 percent per year at OAK, 1.6 percent per year at SJC and 1.2 percent per year at SFO. The differences in growth rates among the three airports relates entirely to the actual decline in business jet activity in 2008 and the estimated recovery of business jet operations during the recession impacted period of 2007-2012. After 2012, business jet operations were assumed to grow at the same rates across all three airports.

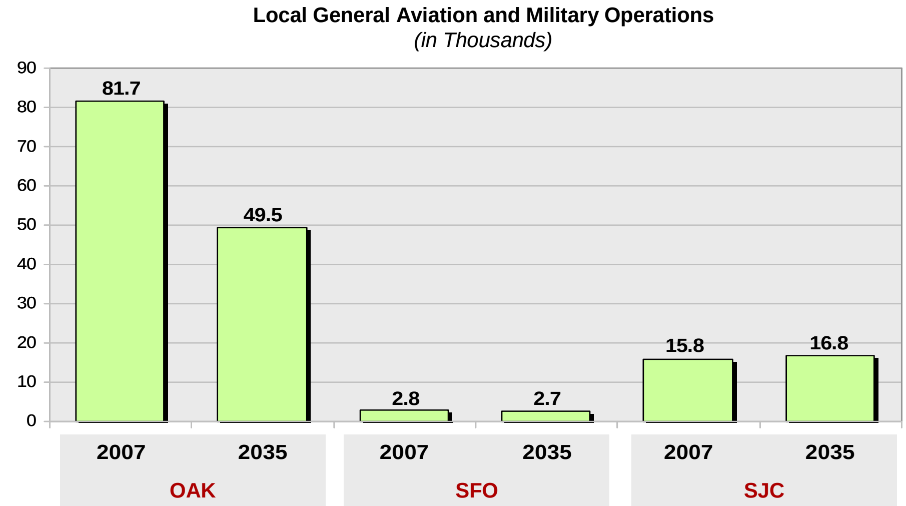
Over the entire forecast period, non-jet GA operations are projected to decline at SFO and Oakland, and increase only slightly at San Jose. At Oakland and San Jose, non-jet GA flights operate from non-carrier runways.

Exhibit 5-8 – General Aviation Jet Operations are Forecast to Increase at Bay Area Airports, While Non-jet Operations will Decrease



Total military and local GA operations in 2035 are forecast to account for 14.1 percent of the total aircraft operations at Oakland, 6.9 percent at San Jose and 0.5 percent at SFO. At Oakland and San Jose, all of the local operations would use non-air carrier runways and do not impact the airport's capacity for commercial airline flights.

Exhibit 5-8 – Actual and Forecast Local GA and Military Operations at the Bay Area Airports



Percent of Total Airport Operations	*24.2%*	*14.1%*	*0.8%*	*0.5%*	*7.9%*	*6.9%*

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Appendix A:
FORECAST WORKING GROUP MEMBERS

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Forecast Working Group Members

1. Gerald Bernstein* (Stanford Transportation Group)
2. Alex Fedor (AvAirPros)
3. Walter Gilfillan (Walter E. Gilfillan and Associates)
4. Elisha Novak (FAA)
5. Linda Perry (Jacobs Consultancy)
6. John Pfeifer (Aircraft Owners and Pilots Association)
7. Michael Roach* (Roach & Sbarra)

* Phase 1 Panel Member

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Appendix B:
Historic and Forecast Airport Passengers

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Historic Bay Area Airport Passengers
1990 - 2008

Enplaned/Deplaned Passengers (Domestic + Interantional)

	Enplaned/Deplaned Passengers				% of Total Bay Area			% Change From Prior Year			
Year	OAK /1	SFO /2	SJC /3	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	5,512,333	31,027,236	6,774,567	43,314,136	12.7%	71.6%	15.6%	-	-	-	-
1991	6,181,251	31,197,209	7,044,942	44,423,402	13.9%	70.2%	15.9%	-	0.5%	4.0%	2.6%
1992	6,542,120	31,789,021	7,084,942	45,416,083	14.4%	70.0%	15.6%	5.8%	1.9%	0.6%	2.2%
1993	7,493,782	32,042,186	7,011,498	46,547,466	16.1%	68.8%	15.1%	14.5%	0.8%	-1.0%	2.5%
1994	8,345,725	33,964,577	8,086,453	50,396,755	16.6%	67.4%	16.0%	11.4%	6.0%	15.3%	8.3%
1995	9,835,025	35,535,157	8,944,172	54,314,354	18.1%	65.4%	16.5%	17.8%	4.6%	10.6%	7.8%
1996	9,734,859	38,560,085	10,010,378	58,305,322	16.7%	66.1%	17.2%	-1.0%	8.5%	11.9%	7.3%
1997	9,144,806	39,870,225	10,214,110	59,229,141	15.4%	67.3%	17.2%	-6.1%	3.4%	2.0%	1.6%
1998	9,231,280	39,292,350	10,511,634	59,035,264	15.6%	66.6%	17.8%	0.9%	-1.4%	2.9%	-0.3%
1999	9,879,556	39,586,540	11,560,605	61,026,701	16.2%	64.9%	18.9%	7.0%	0.7%	10.0%	3.4%
2000	10,620,798	40,317,832	13,097,196	64,035,826	16.6%	63.0%	20.5%	7.5%	1.8%	13.3%	4.9%
2001	11,416,579	33,944,382	13,091,193	58,452,154	19.5%	58.1%	22.4%	7.5%	-15.8%	0.0%	-8.7%
2002	12,723,777	30,741,660	10,935,830	54,401,267	23.4%	56.5%	20.1%	11.4%	-9.4%	-16.5%	-6.9%
2003	13,548,363	28,786,385	10,355,975	52,690,723	25.7%	54.6%	19.7%	6.5%	-6.4%	-5.3%	-3.1%
2004	14,098,327	32,156,828	10,733,532	56,988,687	24.7%	56.4%	18.8%	4.1%	11.7%	3.6%	8.2%
2005	14,417,575	32,794,050	10,756,786	57,968,411	24.9%	56.6%	18.6%	2.3%	2.0%	0.2%	1.7%
2006	14,433,669	33,084,528	10,708,065	58,226,262	24.8%	56.8%	18.4%	0.1%	0.9%	-0.5%	0.4%
2007	14,616,594	35,317,241	10,658,389	60,592,224	24.1%	58.3%	17.6%	1.3%	6.7%	-0.5%	4.1%
2008 /4	11,474,456	37,066,729	9,717,717	58,258,902	19.7%	63.6%	16.7%	-21.5%	5.0%	-8.8%	-3.9%
AAG											
1990-1995	-	2.8%	5.7%	4.6%							
1995-2000	1.5%	2.6%	7.9%	3.3%							
2000-2007	4.7%	-1.9%	-2.9%	-0.8%							
1990-2007	***5.9%***	***0.8%***	***2.7%***	***2.0%***							

Note: Includes connecting passengers

Sources:

/1 Oakland International Airport website and ACI-NA Airport Traffic Statistics, various years.

/2 San Francisco International Airport website and ACI-NA Airport Traffic Statistics, various years

/3 San Jose International Airport, Monthly Activity Reports, December 1991 - December 2007 and ACI-NA Airport Traffic Statistics, various years.

/4 December 2008 traffic reports from individual airports

Historic Bay Area Airport Passengers
1990 - 2008

Local Passengers (Domestic + International)

	Local Passengers				% of Total Bay Area			% Change From Prior Year			
Year	OAK /1	SFO /2	SJC /3	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	5,408,612	23,815,638	5,423,886	34,648,136	15.6%	68.7%	15.7%	-	-	-	-
1991	6,001,668	23,797,950	5,385,569	35,185,187	17.1%	67.6%	15.3%	-	-0.1%	-0.7%	1.6%
1992	6,352,025	23,929,631	5,574,640	35,856,296	17.7%	66.7%	15.5%	5.8%	0.6%	3.5%	1.9%
1993	7,348,593	24,338,499	6,306,098	37,993,191	19.3%	64.1%	16.6%	15.7%	1.7%	13.1%	6.0%
1994	7,889,704	25,071,161	7,567,733	40,528,599	19.5%	61.9%	18.7%	7.4%	3.0%	20.0%	6.7%
1995	9,104,173	26,091,900	8,476,674	43,672,746	20.8%	59.7%	19.4%	15.4%	4.1%	12.0%	7.8%
1996	9,145,625	28,362,129	9,546,227	47,053,982	19.4%	60.3%	20.3%	0.5%	8.7%	12.6%	7.7%
1997	8,681,011	29,769,870	9,827,450	48,278,330	18.0%	61.7%	20.4%	-5.1%	5.0%	2.9%	2.6%
1998	8,760,393	29,724,728	10,117,288	48,602,409	18.0%	61.2%	20.8%	0.9%	-0.2%	2.9%	0.7%
1999	9,327,084	30,632,217	11,039,727	50,999,029	18.3%	60.1%	21.6%	6.5%	3.1%	9.1%	4.9%
2000	10,054,151	31,504,629	12,318,286	53,877,066	18.7%	58.5%	22.9%	7.8%	2.8%	11.6%	5.6%
2001	10,835,479	25,297,500	11,925,049	48,058,028	22.5%	52.6%	24.8%	7.8%	-19.7%	-3.2%	-10.8%
2002	12,266,289	22,406,858	10,220,934	44,894,081	27.3%	49.9%	22.8%	13.2%	-11.4%	-14.3%	-6.6%
2003	13,065,452	20,888,202	9,679,144	43,632,798	29.9%	47.9%	22.2%	6.5%	-6.8%	-5.3%	-2.8%
2004	13,561,501	23,325,239	10,008,018	46,894,758	28.9%	49.7%	21.3%	3.8%	11.7%	3.4%	7.5%
2005	13,890,247	24,103,383	10,044,428	48,038,058	28.9%	50.2%	20.9%	2.4%	3.3%	0.4%	2.4%
2006	13,733,753	24,228,839	10,088,737	48,051,328	28.6%	50.4%	21.0%	-1.1%	0.5%	0.4%	0.0%
2007	13,800,752	26,249,281	10,151,728	50,201,761	27.5%	52.3%	20.2%	0.5%	8.3%	0.6%	4.5%
2008	10,836,657	27,540,811	9,255,332	47,632,801	22.8%	57.8%	19.4%	-21.5%	4.9%	-8.8%	-5.1%
AAG											
1990-1995	-	1.8%	9.3%	4.7%							
1995-2000	2.0%	3.8%	7.8%	4.3%							
2000-2007	4.6%	-2.6%	-2.7%	-1.0%							
1990-2007	***5.7%***	***0.6%***	***3.8%***	***2.2%***							

Note: Excludes connecting passengers

Source: SH&E analysis of US DOT, O&D Survey and T-100 databases and Airport reported traffic statistics.

Historic Bay Area Airport Passengers
1990 - 2008

Connecting Passengers (Domestic + International)

	Connecting Passengers				% of Total Bay Area			% Change From Prior Year			
Year	OAK	SFO	SJC	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	103,721	7,211,598	1,350,681	8,666,000	1.2%	83.2%	15.6%	-	-	-	-
1991	179,583	7,399,259	1,659,373	9,238,215	1.9%	80.1%	18.0%	-	2.6%	22.9%	6.6%
1992	190,095	7,859,390	1,510,302	9,559,787	2.0%	82.2%	15.8%	5.9%	6.2%	-9.0%	3.5%
1993	145,189	7,703,687	705,400	8,554,275	1.7%	90.1%	8.2%	-23.6%	-2.0%	-53.3%	-10.5%
1994	456,021	8,893,416	518,720	9,868,156	4.6%	90.1%	5.3%	214.1%	15.4%	-26.5%	15.4%
1995	730,852	9,443,257	467,498	10,641,608	6.9%	88.7%	4.4%	60.3%	6.2%	-9.9%	7.8%
1996	589,234	10,197,956	464,151	11,251,340	5.2%	90.6%	4.1%	-19.4%	8.0%	-0.7%	5.7%
1997	463,795	10,100,355	386,660	10,950,811	4.2%	92.2%	3.5%	-21.3%	-1.0%	-16.7%	-2.7%
1998	470,887	9,567,622	394,346	10,432,855	4.5%	91.7%	3.8%	1.5%	-5.3%	2.0%	-4.7%
1999	552,472	8,954,323	520,878	10,027,672	5.5%	89.3%	5.2%	17.3%	-6.4%	32.1%	-3.9%
2000	566,647	8,813,203	778,910	10,158,760	5.6%	86.8%	7.7%	2.6%	-1.6%	49.5%	1.3%
2001	581,100	8,646,882	1,166,144	10,394,126	5.6%	83.2%	11.2%	2.6%	-1.9%	49.7%	2.3%
2002	457,488	8,334,802	714,896	9,507,186	4.8%	87.7%	7.5%	-21.3%	-3.6%	-38.7%	-8.5%
2003	482,911	7,898,183	676,831	9,057,925	5.3%	87.2%	7.5%	5.6%	-5.2%	-5.3%	-4.7%
2004	536,826	8,831,589	725,514	10,093,929	5.3%	87.5%	7.2%	11.2%	11.8%	7.2%	11.4%
2005	527,328	8,690,667	712,358	9,930,353	5.3%	87.5%	7.2%	-1.8%	-1.6%	-1.8%	-1.6%
2006	699,916	8,855,689	619,328	10,174,934	6.9%	87.0%	6.1%	32.7%	1.9%	-13.1%	2.5%
2007	815,842	9,067,960	506,661	10,390,463	7.9%	87.3%	4.9%	16.6%	2.4%	-18.2%	2.1%
2008	637,799	9,525,918	462,385	10,626,101	6.0%	89.6%	4.4%	-21.8%	5.1%	-8.7%	2.3%
AAG											
1990-1995	47.8%	5.5%	-19.1%	4.2%							
1995-2000	-5.0%	-1.4%	10.7%	-0.9%							
2000-2007	5.3%	0.4%	-6.0%	0.3%							
1990-2007	***12.9%***	***1.4%***	***-5.6%***	***1.1%***							

Source: SH&E analysis of US DOT, O&D Survey and T-100 databases and Airport reported traffic statistics.

Historic Bay Area Airport Passengers
1990 - 2008

Enplaned/Deplaned Passengers (Domestic)

	Domestic Enplaned/Deplaned Passengers				% of Total Bay Area			% Change From Prior Year			
Year	OAK /1	SFO /2	SJC /3	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	5,512,333	26,717,114	6,685,793	38,915,240	14.2%	68.7%	17.2%	-	-	-	-
1991	6,121,666	27,366,254	6,894,936	40,382,856	15.2%	67.8%	17.1%	11.1%	2.4%	3.1%	3.8%
1992	6,419,872	27,575,147	6,883,479	40,878,498	15.7%	67.5%	16.8%	4.9%	0.8%	-0.2%	1.2%
1993	7,343,428	27,433,409	6,838,118	41,614,955	17.6%	65.9%	16.4%	14.4%	-0.5%	-0.7%	1.8%
1994	8,269,331	28,726,379	7,890,603	44,886,313	18.4%	64.0%	17.6%	12.6%	4.7%	15.4%	7.9%
1995	9,750,146	29,679,982	8,724,185	48,154,313	20.2%	61.6%	18.1%	17.9%	3.3%	10.6%	7.3%
1996	9,588,249	31,915,731	9,771,867	51,275,847	18.7%	62.2%	19.1%	-1.7%	7.5%	12.0%	6.5%
1997	8,998,446	32,810,669	9,929,063	51,738,178	17.4%	63.4%	19.2%	-6.2%	2.8%	1.6%	0.9%
1998	9,069,729	32,471,594	10,180,188	51,721,511	17.5%	62.8%	19.7%	0.8%	-1.0%	2.5%	0.0%
1999	9,708,748	32,248,394	11,225,330	53,182,472	18.3%	60.6%	21.1%	7.0%	-0.7%	10.3%	2.8%
2000	10,486,062	32,236,666	12,733,833	55,456,561	18.9%	58.1%	23.0%	8.0%	0.0%	13.4%	4.3%
2001	11,298,472	26,404,659	12,680,694	50,383,825	22.4%	52.4%	25.2%	7.7%	-18.1%	-0.4%	-9.1%
2002	12,498,965	23,463,770	10,676,294	46,639,029	26.8%	50.3%	22.9%	10.6%	-11.1%	-15.8%	-7.4%
2003	13,176,630	22,091,234	10,111,931	45,379,795	29.0%	48.7%	22.3%	5.4%	-5.8%	-5.3%	-2.7%
2004	13,810,422	24,594,752	10,463,037	48,868,211	28.3%	50.3%	21.4%	4.8%	11.3%	3.5%	7.7%
2005	14,107,686	24,740,291	10,483,671	49,331,648	28.6%	50.2%	21.3%	2.2%	0.6%	0.2%	0.9%
2006	14,237,453	24,595,770	10,441,993	49,275,216	28.9%	49.9%	21.2%	0.9%	-0.6%	-0.4%	-0.1%
2007	14,455,632	26,354,276	10,505,188	51,315,096	28.2%	51.4%	20.5%	1.5%	7.1%	0.6%	4.1%
2008 /4	11,295,700	28,102,527	9,589,026	48,987,254	23.1%	57.4%	19.6%	-21.9%	6.6%	-8.7%	-4.5%
AAG											
1990-1995	12.1%	2.1%	5.5%	4.4%							
1995-2000	1.5%	1.7%	7.9%	2.9%							
2000-2007	4.7%	-2.8%	-2.7%	-1.1%							
1990-2007	***5.8%***	***-0.1%***	***2.7%***	***1.6%***							

Note: Includes connecting passengers
OAK and SJC 2008 equals reproted total airport enp/dep minus estmated international enp/dep passengers.

Sources:
/1 Oakland International Airport website and ACI-NA Airport Traffic Statistics, various years.
/2 San Francisco International Airport website and ACI-NA Airport Traffic Statistics, various years
/3 San Jose International Airport, Monthly Activity Reports, December 1991 - December 2007 and ACI-NA Airport Traffic Statistics, various years.
/4 December 2008 traffic reports from individual airports

Historic Bay Area Airport Passengers
1990 - 2008

Local Passengers (Domestic)

	Domestic Local Passengers				% of Total Bay Area			% Change From Prior Year			
Year	OAK /1	SFO /2	SJC /3	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	5,408,612	20,585,890	5,363,851	31,358,353	17.2%	65.6%	17.1%	-	-	-	-
1991	5,942,235	21,014,242	5,278,548	32,235,025	18.4%	65.2%	16.4%	9.9%	2.1%	-1.6%	2.8%
1992	6,229,913	20,970,429	5,432,648	32,632,990	19.1%	64.3%	16.6%	4.8%	-0.2%	2.9%	1.2%
1993	7,198,683	21,091,937	6,180,785	34,471,405	20.9%	61.2%	17.9%	15.6%	0.6%	13.8%	5.6%
1994	7,813,393	21,240,560	7,405,142	36,459,095	21.4%	58.3%	20.3%	8.5%	0.7%	19.8%	5.8%
1995	9,019,413	21,758,283	8,287,350	39,065,047	23.1%	55.7%	21.2%	15.4%	2.4%	11.9%	7.1%
1996	8,999,240	23,479,739	9,340,502	41,819,480	21.5%	56.1%	22.3%	-0.2%	7.9%	12.7%	7.1%
1997	8,535,033	24,506,350	9,591,834	42,633,217	20.0%	57.5%	22.5%	-5.2%	4.4%	2.7%	1.9%
1998	8,599,476	24,400,908	9,837,627	42,838,011	20.1%	57.0%	23.0%	0.8%	-0.4%	2.6%	0.5%
1999	9,157,751	24,807,666	10,759,370	44,724,786	20.5%	55.5%	24.1%	6.5%	1.7%	9.4%	4.4%
2000	9,919,962	25,177,180	12,027,234	47,124,376	21.1%	53.4%	25.5%	8.3%	1.5%	11.8%	5.4%
2001	10,717,572	19,494,096	11,634,055	41,845,723	25.6%	46.6%	27.8%	8.0%	-22.6%	-3.3%	-11.2%
2002	12,041,608	16,935,394	10,036,031	39,013,033	30.9%	43.4%	25.7%	12.4%	-13.1%	-13.7%	-6.8%
2003	12,693,978	15,791,660	9,500,235	37,985,873	33.4%	41.6%	25.0%	5.4%	-6.8%	-5.3%	-2.6%
2004	13,273,948	17,639,555	9,804,110	40,717,614	32.6%	43.3%	24.1%	4.6%	11.7%	3.2%	7.2%
2005	13,581,233	17,985,673	9,833,363	41,400,268	32.8%	43.4%	23.8%	2.3%	2.0%	0.3%	1.7%
2006	13,537,800	17,786,599	9,868,727	41,193,126	32.9%	43.2%	24.0%	-0.3%	-1.1%	0.4%	-0.5%
2007	13,640,687	19,455,237	9,999,760	43,095,685	31.7%	45.1%	23.2%	0.8%	9.4%	1.3%	4.6%
2008	10,658,899	20,745,830	9,127,677	40,532,406	26.3%	51.2%	22.5%	-21.9%	6.6%	-8.7%	-5.9%
AAG											
1990-1995	10.8%	1.1%	9.1%	4.5%							
1995-2000	1.9%	3.0%	7.7%	3.8%							
2000-2007	4.7%	-3.6%	-2.6%	-1.3%							
1990-2007	***5.6%***	***-0.3%***	***3.7%***	***1.9%***							

Note: Excludes connecting passengers
2008 local O&D for SJC from SJC Airport Statistics.

Source: SH&E analysis of US DOT, O&D Survey and T-100 databases and Airport reported traffic statistics.

Historic Bay Area Airport Passengers
1990 - 2008

Domestic Connecting Passengers

	Domestic Connecting Passengers				% of Total Bay Area			% Change From Prior Year			
Year	OAK	SFO	SJC	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	103,721	6,131,224	1,321,942	7,556,887	1.4%	81.1%	17.5%	-	-	-	-
1991	179,431	6,352,012	1,616,388	8,147,831	2.2%	78.0%	19.8%	73.0%	3.6%	22.3%	7.8%
1992	189,959	6,604,718	1,450,831	8,245,508	2.3%	80.1%	17.6%	5.9%	4.0%	-10.2%	1.2%
1993	144,745	6,341,472	657,333	7,143,550	2.0%	88.8%	9.2%	-23.8%	-4.0%	-54.7%	-13.4%
1994	455,938	7,485,819	485,461	8,427,218	5.4%	88.8%	5.8%	215.0%	18.0%	-26.1%	18.0%
1995	730,733	7,921,699	436,835	9,089,266	8.0%	87.2%	4.8%	60.3%	5.8%	-10.0%	7.9%
1996	589,009	8,435,992	431,365	9,456,367	6.2%	89.2%	4.6%	-19.4%	6.5%	-1.3%	4.0%
1997	463,413	8,304,319	337,229	9,104,961	5.1%	91.2%	3.7%	-21.3%	-1.6%	-21.8%	-3.7%
1998	470,253	8,070,686	342,561	8,883,500	5.3%	90.9%	3.9%	1.5%	-2.8%	1.6%	-2.4%
1999	550,997	7,440,728	465,960	8,457,686	6.5%	88.0%	5.5%	17.2%	-7.8%	36.0%	-4.8%
2000	566,100	7,059,486	706,599	8,332,185	6.8%	84.7%	8.5%	2.7%	-5.1%	51.6%	-1.5%
2001	580,900	6,910,563	1,046,639	8,538,102	6.8%	80.9%	12.3%	2.6%	-2.1%	48.1%	2.5%
2002	457,357	6,528,376	640,263	7,625,996	6.0%	85.6%	8.4%	-21.3%	-5.5%	-38.8%	-10.7%
2003	482,652	6,299,574	611,696	7,393,922	6.5%	85.2%	8.3%	5.5%	-3.5%	-4.5%	-3.0%
2004	536,474	6,955,197	658,927	8,150,597	6.6%	85.3%	8.1%	11.2%	10.4%	7.7%	10.2%
2005	526,453	6,754,618	650,308	7,931,380	6.6%	85.2%	8.2%	-1.9%	-2.9%	-1.3%	-2.7%
2006	699,653	6,809,171	573,266	8,082,090	8.7%	84.3%	7.1%	32.9%	0.8%	-11.8%	1.9%
2007	814,945	6,899,039	505,428	8,219,411	9.9%	83.9%	6.1%	16.5%	1.3%	-11.8%	1.7%
2008	636,802	7,356,697	461,349	8,454,848	7.5%	87.0%	5.5%	-21.9%	6.6%	-8.7%	2.9%
AAG											
1990-1995	47.8%	5.3%	-19.9%	3.8%							
1995-2000	-5.0%	-2.3%	10.1%	-1.7%							
2000-2007	5.3%	-0.3%	-4.7%	-0.2%							
1990-2007	***12.9%***	***0.7%***	***-5.5%***	***0.5%***							

Source: SH&E analysis of US DOT, O&D Survey and T-100 databases and Airport reported traffic statistics.

Historic Bay Area Airport Passengers
1990 - 2008

Enplaned/Deplaned Passengers (International)

Year	International Enplaned/Deplaned Passengers				% of Total Bay Area			% Change From Prior Year			
	OAK /1	SFO /2	SJC /3	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	0	4,310,122	88,774	4,398,896	0.0%	98.0%	2.0%	-	-	-	-
1991	59,585	3,830,955	150,006	4,040,546	1.5%	94.8%	3.7%	-	-11.1%	69.0%	-8.1%
1992	122,248	4,213,874	201,463	4,537,585	2.7%	92.9%	4.4%	105.2%	10.0%	34.3%	12.3%
1993	150,354	4,608,777	173,380	4,932,511	3.0%	93.4%	3.5%	23.0%	9.4%	-13.9%	8.7%
1994	76,394	5,238,198	195,850	5,510,442	1.4%	95.1%	3.6%	-49.2%	13.7%	13.0%	11.7%
1995	84,879	5,855,175	219,987	6,160,041	1.4%	95.1%	3.6%	11.1%	11.8%	12.3%	11.8%
1996	146,610	6,644,354	238,511	7,029,475	2.1%	94.5%	3.4%	72.7%	13.5%	8.4%	14.1%
1997	146,360	7,059,556	285,047	7,490,963	2.0%	94.2%	3.8%	-0.2%	6.2%	19.5%	6.6%
1998	161,551	6,820,756	331,446	7,313,753	2.2%	93.3%	4.5%	10.4%	-3.4%	16.3%	-2.4%
1999	170,808	7,338,146	335,275	7,844,229	2.2%	93.5%	4.3%	5.7%	7.6%	1.2%	7.3%
2000	134,736	8,081,166	363,363	8,579,265	1.6%	94.2%	4.2%	-21.1%	10.1%	8.4%	9.4%
2001	118,107	7,539,723	410,499	8,068,329	1.5%	93.4%	5.1%	-12.3%	-6.7%	13.0%	-6.0%
2002	224,812	7,277,890	259,536	7,762,238	2.9%	93.8%	3.3%	90.3%	-3.5%	-36.8%	-3.8%
2003	371,733	6,695,151	244,044	7,310,928	5.1%	91.6%	3.3%	65.4%	-8.0%	-6.0%	-5.8%
2004	287,905	7,562,076	270,495	8,120,476	3.5%	93.1%	3.3%	-22.6%	12.9%	10.8%	11.1%
2005	309,889	8,053,759	273,115	8,636,763	3.6%	93.2%	3.2%	7.6%	6.5%	1.0%	6.4%
2006	196,216	8,488,758	266,072	8,951,046	2.2%	94.8%	3.0%	-36.7%	5.4%	-2.6%	3.6%
2007	160,962	8,962,965	153,201	9,277,128	1.7%	96.6%	1.7%	-18.0%	5.6%	-42.4%	3.6%
2008 /4	178,756	8,964,202	128,691	9,271,648	1.9%	96.7%	1.4%	11.1%	0.0%	-16.0%	-0.1%
AAG											
1990-1995	-	6.3%	19.9%	7.0%							
1995-2000	9.7%	6.7%	10.6%	6.8%							
2000-2007	2.6%	1.5%	-11.6%	1.1%							
1990-2007	***-***	***4.4%***	***3.3%***	***4.5%***							

Note: Includes connecting passengers
OAK and SJC International for 2008 estimated as 2007 times percent increase in international for YTD Sep '08 vs. YTD Sep '07 based on T-100 data.

Sources:
/1 Oakland International Airport website and ACI-NA Airport Traffic Statistics, various years.
/2 San Francisco International Airport website and ACI-NA Airport Traffic Statistics, various years
/3 San Jose International Airport, Monthly Activity Reports, December 1991 - December 2007 and ACI-NA Airport Traffic Statistics, various years.
/4 December 2008 traffic reports from individual airports

Historic Bay Area Airport Passengers
1990 - 2008

Local Passengers (International)

Year	International Local Passengers				% of Total Bay Area			% Change From Prior Year			
	OAK /1	SFO /2	SJC /3	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	0	3,229,748	60,035	3,289,783	0.0%	98.2%	1.8%	-	-	-	-
1991	59,433	2,783,708	107,021	2,950,162	2.0%	94.4%	3.6%	-	-13.8%	78.3%	-10.3%
1992	122,112	2,959,202	141,992	3,223,306	3.8%	91.8%	4.4%	105.5%	6.3%	32.7%	9.3%
1993	149,910	3,246,563	125,313	3,521,786	4.3%	92.2%	3.6%	22.8%	9.7%	-11.7%	9.3%
1994	76,312	3,830,601	162,591	4,069,504	1.9%	94.1%	4.0%	-49.1%	18.0%	29.7%	15.6%
1995	84,759	4,333,616	189,324	4,607,700	1.8%	94.1%	4.1%	11.1%	13.1%	16.4%	13.2%
1996	146,385	4,882,391	205,725	5,234,501	2.8%	93.3%	3.9%	72.7%	12.7%	8.7%	13.6%
1997	145,978	5,263,520	235,615	5,645,113	2.6%	93.2%	4.2%	-0.3%	7.8%	14.5%	7.8%
1998	160,917	5,323,819	279,661	5,764,397	2.8%	92.4%	4.9%	10.2%	1.1%	18.7%	2.1%
1999	169,334	5,824,552	280,357	6,274,243	2.7%	92.8%	4.5%	5.2%	9.4%	0.2%	8.8%
2000	134,189	6,327,449	291,052	6,752,690	2.0%	93.7%	4.3%	-20.8%	8.6%	3.8%	7.6%
2001	117,907	5,803,405	290,994	6,212,305	1.9%	93.4%	4.7%	-12.1%	-8.3%	0.0%	-8.0%
2002	224,682	5,471,464	184,903	5,881,049	3.8%	93.0%	3.1%	90.6%	-5.7%	-36.5%	-5.3%
2003	371,474	5,096,541	178,909	5,646,924	6.6%	90.3%	3.2%	65.3%	-6.9%	-3.2%	-4.0%
2004	287,552	5,685,683	203,908	6,177,143	4.7%	92.0%	3.3%	-22.6%	11.6%	14.0%	9.4%
2005	309,014	6,117,710	211,066	6,637,790	4.7%	92.2%	3.2%	7.5%	7.6%	3.5%	7.5%
2006	195,953	6,442,239	220,009	6,858,202	2.9%	93.9%	3.2%	-36.6%	5.3%	4.2%	3.3%
2007	160,064	6,794,044	151,968	7,106,076	2.3%	95.6%	2.1%	-18.3%	5.5%	-30.9%	3.6%
2008	177,759	6,794,981	127,655	7,100,395	2.5%	95.7%	1.8%	11.1%	0.0%	-16.0%	-0.1%
AAG											
1990-1995	-	6.1%	25.8%	7.0%							
1995-2000	9.6%	7.9%	9.0%	7.9%							
2000-2007	2.6%	1.0%	-8.9%	0.7%							
1990-2007	***-***	***4.5%***	***5.6%***	***4.6%***							

Note: Excludes connecting passengers
2008 local O&D for SJC from SJC Airport Statistics.

Source: SH&E analysis of US DOT, O&D Survey and T-100 databases and Airport reported traffic statistics.

Historic Bay Area Airport Passengers
1990 - 2008

International Connecting Passengers

	International Connecting Passengers				% of Total Bay Area			% Change From Prior Year			
Year	OAK	SFO	SJC	Total	OAK	SFO	SJC	OAK	SFO	SJC	Total
1990	0	1,080,374	28,739	1,109,113	0.0%	97.4%	2.6%	-	-	-	-
1991	152	1,047,247	42,985	1,090,384	0.0%	96.0%	3.9%	-	-3.1%	49.6%	-1.7%
1992	136	1,254,672	59,471	1,314,279	0.0%	95.5%	4.5%	-10.4%	19.8%	38.4%	20.5%
1993	444	1,362,214	48,067	1,410,725	0.0%	96.6%	3.4%	225.5%	8.6%	-19.2%	7.3%
1994	82	1,407,597	33,259	1,440,938	0.0%	97.7%	2.3%	-81.5%	3.3%	-30.8%	2.1%
1995	120	1,521,559	30,663	1,552,341	0.0%	98.0%	2.0%	45.5%	8.1%	-7.8%	7.7%
1996	225	1,761,963	32,786	1,794,974	0.0%	98.2%	1.8%	87.8%	15.8%	6.9%	15.6%
1997	382	1,796,036	49,432	1,845,850	0.0%	97.3%	2.7%	70.1%	1.9%	50.8%	2.8%
1998	634	1,496,937	51,785	1,549,356	0.0%	96.6%	3.3%	65.9%	-16.7%	4.8%	-16.1%
1999	1,474	1,513,594	54,918	1,569,986	0.1%	96.4%	3.5%	132.5%	1.1%	6.0%	1.3%
2000	547	1,753,717	72,311	1,826,575	0.0%	96.0%	4.0%	-62.9%	15.9%	31.7%	16.3%
2001	200	1,736,318	119,505	1,856,024	0.0%	93.6%	6.4%	-63.4%	-1.0%	65.3%	1.6%
2002	130	1,806,426	74,633	1,881,189	0.0%	96.0%	4.0%	-34.8%	4.0%	-37.5%	1.4%
2003	259	1,598,610	65,135	1,664,004	0.0%	96.1%	3.9%	98.7%	-11.5%	-12.7%	-11.5%
2004	353	1,876,393	66,587	1,943,333	0.0%	96.6%	3.4%	36.0%	17.4%	2.2%	16.8%
2005	875	1,936,049	62,049	1,998,973	0.0%	96.9%	3.1%	148.1%	3.2%	-6.8%	2.9%
2006	263	2,046,519	46,063	2,092,844	0.0%	97.8%	2.2%	-69.9%	5.7%	-25.8%	4.7%
2007	898	2,168,921	1,233	2,171,052	0.0%	99.9%	0.1%	241.0%	6.0%	-97.3%	3.7%
2008	997	2,169,221	1,036	2,171,253	0.0%	99.9%	0.0%	11.1%	0.0%	-16.0%	0.0%
AAG											
1990-1995	-	7.1%	1.3%	7.0%							
1995-2000	35.5%	2.9%	18.7%	3.3%							
2000-2007	7.3%	3.1%	-44.1%	2.5%							
1990-2007	***-***	***4.2%***	***-16.9%***	***4.0%***							

Source: SH&E analysis of US DOT, O&D Survey and T-100 databases and Airport reported traffic statistics.

Historic and Forecast Bay Area Airport Passengers
1990 - 2008 and Forecast 2020, 2035

Enplaned/Deplaned Passengers

					Percent of Total		
Year	Domestic Local	International Local	Connecting	Total	Dom Local	Int'l Local	Conx
Actual							
1990	31,358,353	3,289,783	8,666,000	43,314,136	72.4%	7.6%	20.0%
1991	32,235,025	2,950,162	9,238,215	44,423,402	72.6%	6.6%	20.8%
1992	32,632,990	3,223,306	9,559,787	45,416,083	71.9%	7.1%	21.0%
1993	34,471,405	3,521,786	8,554,275	46,547,466	74.1%	7.6%	18.4%
1994	36,459,095	4,069,504	9,868,156	50,396,755	72.3%	8.1%	19.6%
1995	39,065,047	4,607,700	10,641,608	54,314,354	71.9%	8.5%	19.6%
1996	41,819,480	5,234,501	11,251,340	58,305,322	71.7%	9.0%	19.3%
1997	42,633,217	5,645,113	10,950,811	59,229,141	72.0%	9.5%	18.5%
1998	42,838,011	5,764,397	10,432,855	59,035,264	72.6%	9.8%	17.7%
1999	44,724,786	6,274,243	10,027,672	61,026,701	73.3%	10.3%	16.4%
2000	47,124,376	6,752,690	10,158,760	64,035,826	73.6%	10.5%	15.9%
2001	41,845,723	6,212,305	10,394,126	58,452,154	71.6%	10.6%	17.8%
2002	39,013,033	5,881,049	9,507,186	54,401,267	71.7%	10.8%	17.5%
2003	37,985,873	5,646,924	9,057,925	52,690,723	72.1%	10.7%	17.2%
2004	40,717,614	6,177,143	10,093,929	56,988,687	71.4%	10.8%	17.7%
2005	41,400,268	6,637,790	9,930,353	57,968,411	71.4%	11.5%	17.1%
2006	41,193,126	6,858,202	10,174,934	58,226,262	70.7%	11.8%	17.5%
2007	43,095,685	7,106,076	10,390,463	60,592,224	71.1%	11.7%	17.1%
2008 *	40,532,406	7,100,395	10,626,101	58,258,902	69.6%	12.2%	18.2%
Forecast: BASE CASE							
2020	50,813,298	10,545,741	13,948,076	75,307,115	67.5%	14.0%	18.5%
2035	63,484,270	17,695,216	20,137,483	101,316,970	62.7%	17.5%	19.9%
Forecast: LOW CASE							
2020	45,795,803	9,995,372	12,865,302	68,656,477	66.7%	14.6%	18.7%
2035	55,307,963	15,402,058	17,535,438	88,245,459	62.7%	17.5%	19.9%
Forecast: HIGH CASE							
2020	59,957,796	11,191,793	15,707,299	86,856,888	69.0%	12.9%	18.1%
2035	83,398,400	20,533,716	24,827,335	128,759,451	64.8%	15.9%	19.3%

Note: Includes OAK, SFO and SJC
* Domestic/international and connecting partially estimated for 2008.

Sources: Airport statistics and SH&E Analysis.

Actual and Forecast Bay Area Domestic O&D Passengers
Top 50 Markets

CY07 Rank	Market	Actual 2007	Forecast 2035 Base	Forecast 2035 Low	Forecast 2035 High
1	Los Angeles Area *	8,502,247	10,102,154	8,732,755	14,016,043
2	New York	2,958,728	4,349,120	3,715,681	6,047,628
3	San Diego	2,570,674	3,557,524	3,038,656	4,949,200
4	Las Vegas	2,419,655	3,986,539	3,802,174	4,457,100
5	Seattle/Tacoma	1,969,274	3,724,052	3,184,797	4,542,272
6	Chicago	1,599,462	2,436,467	2,081,893	3,387,069
7	Phoenix	1,438,672	1,998,001	1,706,615	2,779,527
8	Portland	1,254,448	2,460,057	2,104,131	2,893,475
9	Denver	1,238,300	2,238,593	1,914,101	2,856,229
10	Washington	1,180,361	1,782,370	1,522,934	2,477,941
11	Boston	1,152,274	1,745,787	1,491,695	2,427,019
12	Honolulu	931,736	924,251	846,121	1,289,164
13	Dallas/Fort Worth	907,816	1,434,236	1,225,690	1,993,248
14	Atlanta	702,062	1,247,860	1,066,907	1,619,357
15	Houston	683,916	1,101,944	941,788	1,531,209
16	Salt Lake City	662,988	1,367,780	1,207,945	1,529,230
17	Minneapolis	617,432	1,015,802	868,237	1,411,282
18	Philadelphia	598,894	970,287	829,284	1,348,207
19	Kahului	458,408	861,994	737,158	1,057,350
20	Austin	449,038	926,391	883,548	1,035,739
21	Detroit	441,699	614,045	524,496	854,225
22	Orlando	411,212	601,679	514,037	836,690
23	Baltimore	386,446	708,300	605,661	891,366
24	Albuquerque	305,411	374,076	319,362	520,907
25	Kansas City	295,566	386,906	330,403	538,493
26	Reno	294,413	358,308	305,893	498,974
27	Miami	286,429	329,137	280,925	458,557
28	St. Louis	274,607	361,057	308,334	502,500
29	Fort Lauderdale/Hollywood	272,873	507,819	434,258	629,400
30	Raleigh/Durham	244,648	504,723	469,474	564,299
31	Tampa	231,567	355,704	303,949	494,452
32	Charlotte	230,605	475,751	453,749	531,907
33	Indianapolis	221,437	354,561	303,022	492,704
34	Tucson	210,301	267,942	228,787	372,998
35	Kauai Island	209,942	362,381	309,796	484,246
36	Kona	205,469	351,930	300,853	473,928
37	Pittsburgh	203,893	247,913	211,646	345,242
38	Boise	199,547	394,480	337,416	460,269
39	Cleveland	195,592	252,989	216,032	352,141
40	Spokane	192,134	337,124	288,223	443,171
41	Palm Springs	184,457	247,968	211,777	345,049
42	Columbus	183,008	315,603	269,805	422,121
43	Nashville	182,712	352,489	301,471	421,438
44	New Orleans	181,104	236,610	202,054	329,317
45	San Antonio	180,375	244,774	209,057	340,579
46	Hartford	170,138	208,129	177,687	289,826
47	Milwaukee	153,599	211,380	180,546	294,083
48	Omaha	127,871	213,068	182,125	294,943
49	Cincinnati	106,372	105,226	96,598	146,774
50	Jacksonville	103,073	180,195	154,055	237,745
	Subtotal	39,182,887	58,693,472	50,933,601	77,516,633
	All Other	3,912,798	4,790,798	4,374,362	5,881,767
	Total Domestic O&D	43,095,685	63,484,270	55,307,963	83,398,400

Source: US DOT O&D Survey and SH&E Forecast.

Actual and Forecast Bay Area Passengers by Airport

Total (Domestic + International)

	Enplaned/Deplaned Passengers			
Year	OAK	SFO	SJC	Total
Actual				
2007	14,616,594	35,317,241	10,658,389	60,592,224
2008	11,474,456	37,066,729	9,717,717	58,258,902
Forecast - Base				
2020	16,332,161	46,124,417	12,850,537	75,307,115
2035	20,655,297	64,356,302	16,305,371	101,316,970
AAG 2007-2035	1.2%	2.2%	1.5%	1.9%
Forecast - Low				
2020	14,740,119	42,314,466	11,601,892	68,656,477
2035	17,994,404	56,046,332	14,204,724	88,245,459
AAG 2007-2035	0.7%	1.7%	1.0%	1.4%
Forecast - High				
2020	19,218,673	52,526,729	15,111,485	86,856,888
2035	27,011,214	80,449,832	21,298,405	128,759,451
AAG 2007-2035	2.2%	3.0%	2.5%	2.7%

Note: Enplaned plus deplaned passengers; includes local and connecting.

Source: SH&E forecast.

Actual and Forecast Bay Area Passengers by Airport

Domestic

	Enplaned/Deplaned Passengers			
Year	**OAK**	**SFO**	**SJC**	**Total**
Actual				
2007	14,455,632	26,354,276	10,505,188	51,315,096
2008	11,295,700	28,102,527	9,589,026	48,987,254
Forecast - Base				
2020	15,890,568	33,212,265	12,419,000	61,521,833
2035	19,854,302	42,813,628	15,518,038	78,185,968
AAG 2007-2035	1.1%	1.7%	1.4%	1.5%
Forecast - Low				
2020	14,321,572	30,076,183	11,192,876	55,590,631
2035	17,297,211	37,295,416	13,519,423	68,112,050
AAG 2007-2035	0.6%	1.2%	0.9%	1.0%
Forecast - High				
2020	18,750,027	38,823,553	14,653,512	72,227,092
2035	26,081,731	55,451,486	20,384,775	101,917,992
AAG 2007-2035	2.1%	2.7%	2.4%	2.5%

Note: Enplaned plus deplaned passengers; includes local and connecting.

Source: SH&E forecast.

Actual and Forecast Bay Area Passengers by Airport

International

Year	OAK	SFO	SJC	Total
	Enplaned/Deplaned Passengers			
Actual				
2007	160,962	8,962,965	153,201	9,277,128
2008	178,756	8,964,202	128,691	9,271,648
Forecast - Base				
2020	441,593	12,912,152	431,537	13,785,282
2035	800,995	21,542,674	787,333	23,131,002
AAG 2007-2035	5.9%	3.2%	6.0%	3.3%
Forecast - Low				
2020	418,547	12,238,284	409,016	13,065,846
2035	697,192	18,750,916	685,301	20,133,409
AAG 2007-2035	5.4%	2.7%	5.5%	2.8%
Forecast - High				
2020	468,646	13,703,176	457,974	14,629,795
2035	929,483	24,998,346	913,630	26,841,459
AAG 2007-2035	6.5%	3.7%	6.6%	3.9%

Note: Enplaned plus deplaned passengers; includes local and connecting.

Source: SH&E forecast.

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Appendix C:
HISTORIC AND FORECAST CARGO DEMAND

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Historic Cargo and Mail Tons at Bay Area Airports

(Enplaned + Deplaned)

	Oakland (OAK)				San Francisco (SFO)				San Jose (SJC)			
Year	Belly	All-Cargo	Mail	Total	Belly	All-Cargo	Mail	Total	Belly	All-Cargo	Mail	Total
1994	6,212	532,832	9,141	548,185	363,891	234,320	150,019	748,230	17,409	70,265	7,214	94,888
1995	6,649	583,970	9,079	599,698	364,649	250,731	152,167	767,547	17,556	77,186	7,105	101,847
1996	7,554	660,579	10,256	678,389	370,216	251,793	162,681	784,690	15,125	88,529	6,980	110,634
1997	8,672	727,376	11,564	747,612	396,461	286,561	176,814	859,836	16,976	97,629	8,104	122,708
1998	8,652	758,620	12,132	779,404	370,245	289,576	191,200	851,021	15,591	109,898	7,826	133,316
1999	8,284	736,854	9,607	754,745	373,181	349,283	205,917	928,381	16,884	119,630	6,880	143,394
2000	8,261	757,947	8,788	774,996	386,297	380,093	195,102	961,493	19,383	134,128	9,586	163,097
2001	6,948	655,565	8,290	670,803	318,568	250,426	131,129	700,124	19,317	130,679	8,675	158,670
2002	8,197	702,901	5,963	717,061	321,127	236,733	99,069	656,929	15,878	134,301	4,343	154,523
2003	9,529	667,650	6,176	683,355	274,422	258,449	99,329	632,200	13,578	101,808	4,930	120,317
2004	11,385	723,209	6,881	741,475	272,429	267,456	80,577	620,462	13,222	102,078	4,614	119,914
2005	12,184	723,634	5,878	741,696	292,690	280,937	77,350	650,977	12,103	88,655	3,903	104,661
2006	12,327	718,212	6,057	736,596	296,773	286,683	72,261	655,717	9,489	88,293	3,263	101,045
2007	12,163	694,537	7,165	713,866	294,255	261,198	65,074	620,527	4,057	85,792	1,577	91,426
Percent Change Over Prior Year												
1995	7.0%	9.6%	-0.7%	9.4%	0.2%	7.0%	1.4%	2.6%	0.8%	9.9%	-1.5%	7.3%
1996	13.6%	13.1%	13.0%	13.1%	1.5%	0.4%	6.9%	2.2%	-13.8%	14.7%	-1.8%	8.6%
1997	14.8%	10.1%	12.8%	10.2%	7.1%	13.8%	8.7%	9.6%	12.2%	10.3%	16.1%	10.9%
1998	-0.2%	4.3%	4.9%	4.3%	-6.6%	1.1%	8.1%	-1.0%	-8.2%	12.6%	-3.4%	8.6%
1999	-4.3%	-2.9%	-20.8%	-3.2%	0.8%	20.6%	7.7%	9.1%	8.3%	8.9%	-12.1%	7.6%
2000	-0.3%	2.9%	-8.5%	2.7%	3.5%	8.8%	-5.3%	3.6%	14.8%	12.1%	39.3%	13.7%
2001	-15.9%	-13.5%	-5.7%	-13.4%	-17.5%	-34.1%	-32.8%	-27.2%	-0.3%	-2.6%	-9.5%	-2.7%
2002	18.0%	7.2%	-28.1%	6.9%	0.8%	-5.5%	-24.4%	-6.2%	-17.8%	2.8%	-49.9%	-2.6%
2003	16.2%	-5.0%	3.6%	-4.7%	-14.5%	9.2%	0.3%	-3.8%	-14.5%	-24.2%	13.5%	-22.1%
2004	19.5%	8.3%	11.4%	8.5%	-0.7%	3.5%	-18.9%	-1.9%	-2.6%	0.3%	-6.4%	-0.3%
2005	7.0%	0.1%	-14.6%	0.0%	7.4%	5.0%	-4.0%	4.9%	-8.5%	-13.1%	-15.4%	-12.7%
2006	1.2%	-0.7%	3.0%	-0.7%	1.4%	2.0%	-6.6%	0.7%	-21.6%	-0.4%	-16.4%	-3.5%
2007	-1.3%	-3.3%	18.3%	-3.1%	-0.8%	-8.9%	-9.9%	-5.4%	-57.2%	-2.8%	-51.7%	-9.5%
2008												
Avg. Annual Growth												
1994-2000	4.9%	6.0%	-0.7%	5.9%	1.0%	8.4%	4.5%	4.3%	1.8%	11.4%	4.9%	9.4%
2000-2007	5.7%	-1.2%	-2.9%	-1.2%	-3.8%	-5.2%	-14.5%	-6.1%	-20.0%	-6.2%	-22.7%	-7.9%
1994-2007	5.3%	2.1%	-1.9%	2.1%	-1.6%	0.8%	-6.2%	-1.4%	-10.6%	1.5%	-11.0%	-0.3%

Source: T100 Onflight Database and Airport Statistical Reports.

Historic Cargo and Mail Tons at San Francisco International Airport

(Domestic and Internaitonal)

	Domestic Cargo			International Cargo			Mail			Total Cargo
Year	Belly	All-Cargo	Total	Belly	All-Cargo	Total	Dom	Int'l	Total	+ Mail
1994	203,008	103,672	306,680	160,883	130,648	291,531	130,101	19,918	150,019	748,230
1995	183,580	96,949	280,529	181,069	153,782	334,851	129,650	22,517	152,167	767,547
1996	178,017	70,982	248,999	192,199	180,811	373,010	137,682	24,999	162,681	784,690
1997	187,029	88,059	275,088	209,432	198,502	407,934	151,458	25,356	176,814	859,836
1998	176,633	93,447	270,080	193,612	196,128	389,740	161,799	29,401	191,200	851,021
1999	175,072	122,344	297,416	198,109	226,940	425,048	180,059	25,857	205,917	928,381
2000	175,299	115,904	291,203	210,998	264,189	475,188	166,076	29,026	195,102	961,493
2001	133,373	75,611	208,984	185,195	174,815	360,011	106,133	24,997	131,129	700,124
2002	134,965	73,661	208,626	186,162	163,072	349,234	72,297	26,772	99,069	656,929
2003	114,461	106,926	221,387	159,961	151,523	311,484	70,313	29,016	99,329	632,200
2004	113,322	119,510	232,832	159,108	147,945	307,053	56,830	23,747	80,577	620,462
2005	124,160	136,368	260,528	168,530	144,569	313,099	53,584	23,766	77,350	650,977
2006	124,449	140,095	264,543	172,324	146,588	318,913	40,108	32,153	72,261	655,717
2007	119,322	120,646	239,968	174,932	140,552	315,484	25,320	39,754	65,074	620,527
Percent Change Over Prior Year										
1995	-9.6%	-6.5%	-8.5%	12.5%	17.7%	14.9%	-0.3%	13.0%	1.4%	2.6%
1996	-3.0%	-26.8%	-11.2%	6.1%	17.6%	11.4%	6.2%	11.0%	6.9%	2.2%
1997	5.1%	24.1%	10.5%	9.0%	9.8%	9.4%	10.0%	1.4%	8.7%	9.6%
1998	-5.6%	6.1%	-1.8%	-7.6%	-1.2%	-4.5%	6.8%	16.0%	8.1%	-1.0%
1999	-0.9%	30.9%	10.1%	2.3%	15.7%	9.1%	11.3%	-12.1%	7.7%	9.1%
2000	0.1%	-5.3%	-2.1%	6.5%	16.4%	11.8%	-7.8%	12.3%	-5.3%	3.6%
2001	-23.9%	-34.8%	-28.2%	-12.2%	-33.8%	-24.2%	-36.1%	-13.9%	-32.8%	-27.2%
2002	1.2%	-2.6%	-0.2%	0.5%	-6.7%	-3.0%	-31.9%	7.1%	-24.4%	-6.2%
2003	-15.2%	45.2%	6.1%	-14.1%	-7.1%	-10.8%	-2.7%	8.4%	0.3%	-3.8%
2004	-1.0%	11.8%	5.2%	-0.5%	-2.4%	-1.4%	-19.2%	-18.2%	-18.9%	-1.9%
2005	9.6%	14.1%	11.9%	5.9%	-2.3%	2.0%	-5.7%	0.1%	-4.0%	4.9%
2006	0.2%	2.7%	1.5%	2.3%	1.4%	1.9%	-25.2%	35.3%	-6.6%	0.7%
2007	-4.1%	-13.9%	-9.3%	1.5%	-4.1%	-1.1%	-36.9%	23.6%	-9.9%	-5.4%
AAG										
1994-2000	-2.4%	1.9%	-0.9%	4.6%	12.5%	8.5%	4.2%	6.5%	4.5%	4.3%
2000-2007	-5.3%	0.6%	-2.7%	-2.6%	-8.6%	-5.7%	-23.6%	4.6%	-14.5%	-6.1%
1994-2007	-4.0%	1.2%	-1.9%	0.6%	0.6%	0.6%	-11.8%	5.5%	-6.2%	-1.4%

Source: T100 Onflight Database and Airport Statistical Reports.

Forecast Bay Area Cargo and Mail Volumes by Airport

(Enplaned + Deplaned Tons)

	SFO					OAK			SJC			Total Bay Area		
Year	Dom Belly	Dom All-Cargo	Intl Belly	Intl All-Cargo	Total	Belly	All-Cargo	Total	Belly	All-Cargo	Total	Belly	All-Cargo	Total
Actual 2007	144,178	121,111	213,724	141,515	620,527	14,152	699,714	713,866	5,619	85,807	91,426	377,672	1,048,146	1,425,818
Forecast Base														
2020	160,371	146,407	303,579	222,565	832,921	15,742	845,864	861,605	6,250	103,730	109,980	485,941	1,318,565	1,804,506
2035	191,500	200,846	544,882	473,386	1,410,614	18,797	1,160,380	1,179,177	7,463	142,299	149,762	762,643	1,976,911	2,739,554
Avg. Annual Growth														
2007-2020	0.8%	1.5%	2.7%	3.5%	2.3%	0.8%	1.5%	1.5%	0.8%	1.5%	1.4%	2.0%	1.8%	1.8%
2007-2035	1.0%	1.8%	3.4%	4.4%	3.0%	1.0%	1.8%	1.8%	1.0%	1.8%	1.8%	2.5%	2.3%	2.4%
Forecast Low														
2020	154,802	137,498	270,472	191,866	754,638	15,195	794,388	809,583	6,033	97,417	103,450	446,502	1,221,169	1,667,671
2035	174,277	169,883	400,472	318,659	1,063,291	17,107	981,492	998,599	6,792	120,362	127,154	598,648	1,590,396	2,189,044
Avg. Annual Growth														
2007-2020	0.5%	1.0%	1.8%	2.4%	1.5%	0.5%	1.0%	1.0%	0.5%	1.0%	1.0%	1.3%	1.2%	1.2%
2007-2035	0.7%	1.2%	2.3%	2.9%	1.9%	0.7%	1.2%	1.2%	0.7%	1.2%	1.2%	1.7%	1.5%	1.5%
Forecast High														
2020	166,117	155,827	340,239	257,555	919,737	16,306	900,283	916,588	6,474	110,403	116,877	529,136	1,424,067	1,953,203
2035	210,348	237,177	738,480	698,741	1,884,745	20,647	1,370,282	1,390,929	8,198	168,040	176,238	977,672	2,474,240	3,451,912
Avg. Annual Growth														
2007-2020	1.1%	2.0%	3.6%	4.7%	3.1%	1.1%	2.0%	1.9%	1.1%	2.0%	1.9%	2.6%	2.4%	2.5%
2007-2035	1.4%	2.4%	4.5%	5.9%	4.0%	1.4%	2.4%	2.4%	1.4%	2.4%	2.4%	3.5%	3.1%	3.2%

Source: SH&E Forecast.

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Appendix D:
HISTORIC AND FORECAST GENERAL AVIATION DEMAND

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Historic General Aviation Operations at the Bay Area Airports

(Jet and Non-jet)

Year	Business Jets				Non-jets				Total GA Operations			
	OAK	SFO	SJC	Total Bay Area	OAK	SFO	SJC	Total Bay Area	OAK	SFO	SJC	Total Bay Area
2000	12,730	21,415	25,928	60,073	141,439	10,433	68,272	220,144	154,169	31,848	94,200	280,217
2001	14,023	19,470	27,364	60,857	128,706	6,681	48,658	184,045	142,729	26,151	76,022	244,902
2002	15,479	22,603	28,595	66,677	102,780	6,268	37,651	146,699	118,259	28,871	66,246	213,376
2003	15,270	23,496	27,654	66,420	84,781	5,982	35,302	126,065	100,051	29,478	62,956	192,485
2004	16,717	25,462	27,716	69,895	69,733	7,026	32,785	109,544	86,450	32,488	60,501	179,439
2005	19,074	27,346	29,201	75,621	72,446	6,897	30,536	109,879	91,520	34,243	59,737	185,500
2006	19,060	26,863	28,955	74,878	55,287	6,688	25,873	87,848	74,347	33,551	54,828	162,726
2007	18,608	27,753	28,620	74,981	48,930	6,442	24,609	79,981	67,538	34,195	53,229	154,962
2008	17,661	22,152	24,959	64,772	38,846	4,852	22,242	65,940	56,507	27,005	47,201	130,713
Avg. Annual Growth												
2000-08	4.2%	0.4%	-0.5%	0.9%	-14.9%	-9.1%	-13.1%	-14.0%	-11.8%	-2.0%	-8.3%	-9.1%

Note:GA itinerant operations only; excludes local operations.
Source: FAA, ETMSC and ATADS databases.

Historic and Forecast General Aviation Operations Forecast for the Bay Area Airports

Base Case

	Business Jets				Non-jets				Total GA Operations			
Year	**OAK**	**SFO**	**SJC**	**Total**	**OAK**	**SFO**	**SJC**	**Total**	**OAK**	**SFO**	**SJC**	**Total**
Historic												
2000	12,730	21,415	25,928	60,073	141,439	10,433	68,272	220,144	154,169	31,848	94,200	280,217
2005	19,074	27,346	29,201	75,621	72,446	6,897	30,536	109,879	91,520	34,243	59,737	185,500
2008	17,661	22,152	24,959	64,772	38,846	4,852	22,242	65,940	56,507	27,005	47,201	130,713
Forecast												
2009	15,895	18,829	21,215	55,940	31,077	3,882	20,018	54,976	46,971	22,711	41,233	110,916
2010	16,491	19,535	22,011	58,037	32,242	3,979	20,768	56,989	48,733	23,514	42,779	115,027
2015	19,752	23,399	26,364	69,515	34,620	4,173	22,300	61,093	54,372	27,572	48,664	130,608
2020	23,318	27,623	31,123	82,064	35,938	4,278	23,149	63,366	59,256	31,901	54,272	145,430
2025	27,032	32,023	36,080	95,135	37,306	4,386	24,030	65,723	64,338	36,409	60,111	160,858
2035	33,154	39,275	44,251	116,679	38,729	4,497	24,947	68,173	71,882	43,772	69,198	184,853
AAGR												
2000-08	4.2%	0.4%	-0.5%	0.9%	-14.9%	-9.1%	-13.1%	-14.0%	-11.8%	-2.0%	-8.3%	-9.1%
2008-15	1.6%	0.8%	0.8%	1.0%	-1.6%	-2.1%	0.0%	-1.1%	-0.5%	0.3%	0.4%	0.0%
2015-25	3.2%	3.2%	3.2%	3.2%	0.8%	0.5%	0.8%	0.7%	1.7%	2.8%	2.1%	2.1%
2025-35	2.1%	2.1%	2.1%	2.1%	0.4%	0.2%	0.4%	0.4%	1.1%	1.9%	1.4%	1.4%
2008-35	**2.4%**	**2.1%**	**2.1%**	**2.2%**	**0.0%**	**-0.3%**	**0.4%**	**0.1%**	**0.9%**	**1.8%**	**1.4%**	**1.3%**

Note:GA itinerant operations only; excludes local operations.

Source: FAA, ETMSC and ATADS databases and SH&E Forecast.

Historic and Forecast General Aviation Operations Forecast for the Bay Area Airports

Low Case

	Business Jets				Non-jets				Total GA Operations			
Year	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Historic												
2000	12,730	21,415	25,928	60,073	141,439	10,433	68,272	220,144	154,169	31,848	94,200	280,217
2005	19,074	27,346	29,201	75,621	72,446	6,897	30,536	109,879	91,520	34,243	59,737	185,500
2008	17,661	22,152	24,959	64,772	38,846	4,852	22,242	65,940	56,507	27,005	47,201	130,713
Forecast												
2009	15,895	18,829	21,215	55,940	31,077	3,882	20,018	54,976	46,971	22,711	41,233	110,916
2010	16,491	19,535	22,011	58,037	32,242	3,979	20,768	56,989	48,733	23,514	42,779	115,027
2015	19,539	23,146	26,079	68,764	33,451	4,078	21,547	59,077	52,990	27,224	47,626	127,840
2020	22,241	26,348	29,686	78,275	33,451	4,078	21,547	59,077	55,692	30,426	51,234	137,352
2025	24,859	29,448	33,180	87,486	33,451	4,078	21,547	59,077	58,310	33,527	54,727	146,563
2035	29,386	34,812	39,223	103,421	33,451	4,078	21,547	59,077	62,837	38,890	60,770	162,498
AAGR												
2000-08	4.2%	0.4%	-0.5%	0.9%	-14.9%	-9.1%	-13.1%	-14.0%	-11.8%	-2.0%	-8.3%	-9.1%
2008-15	1.5%	0.6%	0.6%	0.9%	-2.1%	-2.5%	-0.5%	-1.6%	-0.9%	0.1%	0.1%	-0.3%
2015-25	2.4%	2.4%	2.4%	2.4%	0.0%	0.0%	0.0%	0.0%	1.0%	2.1%	1.4%	1.4%
2025-35	1.7%	1.7%	1.7%	1.7%	0.0%	0.0%	0.0%	0.0%	0.8%	1.5%	1.1%	1.0%
2008-35	**1.9%**	**1.7%**	**1.7%**	**1.7%**	**-0.6%**	**-0.6%**	**-0.1%**	**-0.4%**	**0.4%**	**1.4%**	**0.9%**	**0.8%**

Note:GA itinerant operations only; excludes local operations.

Source: FAA, ETMSC and ATADS databases and SH&E Forecast.

Historic and Forecast General Aviation Operations Forecast for the Bay Area Airports

High Case

	Business Jet Operations				Non-jet GA Operations				Total GA Operations			
Year	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Historic												
2000	12,730	21,415	25,928	60,073	141,439	10,433	68,272	220,144	154,169	31,848	94,200	280,217
2005	19,074	27,346	29,201	75,621	72,446	6,897	30,536	109,879	91,520	34,243	59,737	185,500
2008	17,661	22,152	24,959	64,772	38,846	4,852	22,242	65,940	56,507	27,005	47,201	130,713
Forecast												
2009	15,895	18,829	21,215	55,940	31,077	3,882	20,018	54,976	46,971	22,711	41,233	110,916
2010	16,491	19,535	22,011	58,037	32,242	3,979	20,768	56,989	48,733	23,514	42,779	115,027
2015	20,918	24,780	27,920	73,618	35,810	4,269	23,067	63,146	56,728	29,049	50,987	136,764
2020	25,146	29,788	33,563	88,496	37,451	4,398	24,124	65,973	62,596	34,186	57,686	154,469
2025	29,685	35,166	39,622	104,473	38,876	4,509	25,042	68,428	68,562	39,675	64,664	172,901
2035	37,768	44,741	50,410	132,918	40,662	4,647	26,192	71,500	78,429	49,387	76,602	204,419
AAGR												
2000-08	4.2%	0.4%	-0.5%	0.9%	-14.9%	-9.1%	-13.1%	-14.0%	-11.8%	-2.0%	-8.3%	-9.1%
2008-15	2.4%	1.6%	1.6%	1.8%	-1.2%	-1.8%	0.5%	-0.6%	0.1%	1.0%	1.1%	0.6%
2015-25	3.6%	3.6%	3.6%	3.6%	0.8%	0.5%	0.8%	0.8%	1.9%	3.2%	2.4%	2.4%
2025-35	2.4%	2.4%	2.4%	2.4%	0.4%	0.3%	0.4%	0.4%	1.4%	2.2%	1.7%	1.7%
2008-35	2.9%	2.6%	2.6%	2.7%	0.2%	-0.2%	0.6%	0.3%	1.2%	2.3%	1.8%	1.7%

Note:GA itinerant operations only; excludes local operations.

Source: FAA, ETMSC and ATADS databases and SH&E Forecast.

Historic and Forecast Local General Aviation Operations for the Bay Area Airports

	Base Case				High Case				Low Case			
Year	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Historic												
2000	108,260	1,329	51,128	160,717	108,260	1,329	51,128	160,717	108,260	1,329	51,128	160,717
2007	81,332	68	15,682	97,082	81,332	68	15,682	97,082	81,332	68	15,682	97,082
2008	46,031	134	15,477	61,642	46,031	134	15,477	61,642	46,031	134	15,477	61,642
Forecast												
2020	46,031	0	15,477	61,508	47,925	0	16,114	64,039	42,915	0	14,429	57,345
2035	49,971	0	16,769	66,740	52,034	0	17,495	69,529	42,915	0	14,429	57,345
AAGR												
2000-08	-10.1%	-24.9%	-13.9%	-11.3%	-10.1%	-24.9%	-13.9%	-11.3%	-10.1%	-24.9%	-13.9%	-11.3%
2008-20	0.0%	-	0.0%	0.0%	0.3%	-	0.3%	0.3%	-0.6%	-	-0.6%	-0.6%
2020-35	0.5%	-	0.5%	0.5%	0.5%	-	0.5%	0.5%	0.0%	-	0.0%	0.0%
2008-35	0.3%	-	0.3%	0.3%	0.5%	-	0.5%	0.4%	-0.3%	-	-0.3%	-0.3%

Note:GA local operations only.

Source: FAA, ATADS database and SH&E Forecast.

Historic and Forecast Military Operations for the Bay Area Airports

Year	Base, Low, and High Cases OAK	SFO	SJC	Total
Historic				
2007	396	2,697	100	3,193
Forecast				
2020	396	2,697	100	3,193
2035	396	2,697	100	3,193

Note: Includes local and itinerant operations.

Source: FAA, ATADS database and SH&E Forecast.

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Appendix E:
Base Year and Forecast Aircraft Operations and Fleet Mix

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Actual and Forecast Aircraft Operations at Bay Area Airports
Actual 2007, Forecast 2020 and 2035
Base Case

	Estimated Annual Operations - 2007				Forecast Annual Operations - 2020				Forecast Annual Operations - 2035			
Category	**OAK**	**SFO**	**SJC**	**Total**	**OAK**	**SFO**	**SJC**	**Total**	**OAK**	**SFO**	**SJC**	**Total**
Commercial Psgr	155,855	326,230	127,763	609,848	161,079	384,578	129,540	675,197	192,640	461,163	153,040	806,843
Commercial Cargo	32,174	9,759	2,968	44,901	34,329	11,996	3,167	49,492	40,451	18,963	3,732	63,146
Total Commercial	188,029	335,989	130,731	654,749	195,408	396,574	132,707	724,689	233,091	480,126	156,772	869,989
GA - Jets	18,608	27,753	28,620	74,981	23,318	27,623	31,123	82,064	33,154	39,275	44,251	116,680
GA - Nonjets	48,930	6,442	24,609	79,981	35,938	4,278	23,149	63,365	38,729	4,497	24,947	68,173
Total GA (Itinerant)	67,538	34,195	53,229	154,962	59,256	31,901	54,272	145,429	71,883	43,772	69,198	184,853
Subtotal Above	255,567	370,184	183,960	809,711	254,664	428,475	186,979	870,118	304,974	523,898	225,970	1,054,842
Military (Local + Itinerant)	396	2,697	100	3,193	396	2,697	100	3,193	396	2,697	100	3,193
GA - Local	81,332	134	15,682	97,148	46,031	0	15,477	61,508	49,575	0	16,669	66,244
Total GA Local & Military	81,728	2,831	15,782	100,341	46,427	2,697	15,577	64,701	49,971	2,697	16,769	69,437
Total All Operations	337,295	373,015	199,742	910,052	301,091	431,172	202,556	934,819	354,945	526,595	242,739	1,124,279

Source: SH&E Forecasts.

Actual and Forecast Operations by Aircraft Type at OAK

Actual 2007 and Base Case 2020 and 2035

User Groups & Aircraft Types	Actual 2007	Forecast 2020	Forecast 2035
Air Carrier Psgr			
787-9 / A-350	0	0	2,513
767 (all)	0	2,129	0
Widebody Total	0	2,129	2,513
757 (all)	1,822	4,272	0
737-300	47,736	2,555	0
737-400/500	6,448	2,981	0
737-700/800/900	65,762	119,760	152,645
A-318/319/320/321	16,699	20,014	26,426
MD-80 (all)	5,688	0	0
RJs (all)	11,701	9,368	11,056
Narrowbody Total	155,855	158,950	190,127
Psgr Carrier Total	155,855	161,079	192,640
All-Cargo			
747	165	176	207
777	0	4,851	8,574
A330	0	2,810	4,967
DC10/MD11	9,093	4,851	2,858
A300	5,267	2,810	1,656
767	2,795	2,982	3,514
Widebody Total	17,320	18,480	21,776
757	845	905	1,066
DC8	3	0	0
DC9	17	0	0
727	2,763	0	0
737-200/300	2	0	0
737-3/500	0	2,968	1,749
737-7/900	0	0	1,749
Narrowbody Total	3,630	3,873	4,564
LJ35/LR35	5	0	0
AT43/AT72/BA41	897	2,288	3,479
B190/BE99/PA32	2,520	5,566	8,200
SW4	2,494	1,331	784
PA31/SW3	5,223	2,786	1,642
P32R/NAV	23	0	0
UNK	62	0	0
Regional Acft Total	11,224	11,971	14,105
All-Cargo Total	32,174	34,324	40,445

Actual and Forecast Operations by Aircraft Type at OAK

Actual 2007 and Base Case 2020 and 2035

User Groups & Aircraft Types	Actual 2007	Forecast 2020	Forecast 2035
<u>General Aviation (Itinerant)</u>			
GA SEL S	21,073	15,813	18,203
GA SEL L	419	359	387
GA MEL S	9,906	5,391	4,647
GA MEL L	0	0	0
TP S	15,972	11,860	12,781
TP L	1,559	2,516	2,711
Non-jet Total	48,930	35,938	38,729
BJ S	10,081	11,659	14,919
BJ L	8,527	11,659	18,235
Business Jet Total	18,608	23,318	33,154
GA Itinerant Total	67,538	59,256	71,883
GA - Local	81,332	46,031	49,575
Military	396	396	396
Total All Operations	337,295	301,086	354,939

Notes:

SEL = Single engine piston
MEL = Multi engine piston
TP = Turboprop
BJ = Business jet

S = Small (under 44,000 lbs)
L= Large (44,000-300,000 lbs)

Source: SH&E Forecast.

Actual and Forecast Operations by Aircraft Type at SFO

Actual 2007 and Base Case 2020 and 2035

User Groups & Aircraft Types	Actual 2007	Forecast 2020	Forecast 2035
Air Carrier Psgr			
767 (all)	17,424	21,269	0
787-9	0	2,903	35,523
777 (all)	12,284	22,788	26,035
A-330/340	3,171	1,742	3,075
747 (all)	15,064	18,582	27,532
A-380	0	2,323	7,377
Widebody Total	47,943	69,608	99,543
757 (all)	42,834	40,476	0
737-300	16,741	13,009	0
737-400/500	14,536	23,175	0
737-700/800/900	23,859	74,026	139,402
A-318/319/320/321	70,429	86,273	160,657
MD-80 (all)	15,246	1,182	0
Narrowbody Total	183,646	238,142	300,059
RJs (all)	45,272	43,152	41,901
Turboprops (all)	49,369	33,676	19,660
Psgr Carrier Total	326,230	384,578	461,163
All-Cargo			
747	5,975	7,344	11,610
777	7	1,315	3,110
A330	0	219	346
DC10/MD11	2,125	1,306	1,032
A300	178	0	0
767	962	1,182	1,869
Widebody Total	9,247	11,366	17,968
757	1	0	0
DC8	6	0	0
DC9	503	0	0
737-200/300	2	0	0
737-3/4/500	0	629	497
737-7/8/900	0	0	497
Narrowbody Total	512	629	995
All-Cargo Total	9,759	11,996	18,963

Actual and Forecast Operations by Aircraft Type at SFO

Actual 2007 and Base Case 2020 and 2035

User Groups & Aircraft Types	Actual 2007	Forecast 2020	Forecast 2035
General Aviation (Itinerant)			
GA SEL S	411	299	360
GA SEL L	53	43	45
GA MEL S	2,744	1,455	1,259
GA MEL L	41	0	0
TP S	3,186	2,481	2,833
TP L	8	0	0
Non-jet Total	6,442	4,278	4,497
BJ S	11,150	9,668	11,783
BJ L	16,603	17,955	27,493
Business Jet Total	27,753	27,623	39,275
GA Itinerant Total	34,195	31,901	43,772
GA - Local	134	0	0
Military	2,697	2,697	2,697
Total All Operations	373,015	431,172	526,595

Notes:

SEL = Single engine piston
MEL = Multi engine piston
TP = Turboprop
BJ = Business jet

S = Small (under 44,000 lbs)
L= Large (44,000-300,000 lbs)

Source: SH&E Forecast.

Actual and Forecast Operations by Aircraft Type at SJC

Actual 2007 and Base Case 2020 and 2035

User Groups & Aircraft Types	Actual 2007	Forecast 2020	Forecast 2035
Air Carrier Psgr			
767 (all)	730	0	0
Widebody Total	730	0	0
757 (all)	3,273	13,519	0
737-300	28,802	0	0
737-400/500	3,550	0	0
737-700/800/900	34,813	67,074	78,044
A-318/319/320/321	14,454	13,590	58,056
MD-80 (all)	11,632	20,798	0
Narrowbody Total	96,526	114,982	136,101
RJs (all)	25,413	14,559	16,940
TPs (all)	5,095	0	0
Psgr Carrier Total	127,763	129,540	153,040
All-Cargo			
DC10/MD11	909	485	286
A300	275	147	86
777	0	485	857
A330	0	147	259
767	998	1,065	1,255
Widebody Total	2,182	2,328	2,743
757	366	839	988
DC8	413	0	0
DC9	3	0	0
737-200/300	4	0	0
Narrowbody Total	786	839	988
All-Cargo Total	2,968	3,167	3,732

Actual and Forecast Operations by Aircraft Type at SJC

Actual 2007 and Base Case 2020 and 2035

User Groups & Aircraft Types	Actual 2007	Forecast 2020	Forecast 2035
General Aviation (Itinerant)			
GA SEL S	6,425	6,019	6,736
GA SEL L	53	0	0
GA MEL S	3,086	2,083	1,746
GA MEL L	61	0	0
TP S	9,706	9,723	10,727
TP L	5,278	5,324	5,738
Non-jet Total	24,609	23,149	24,947
BJ S	13,164	12,449	15,488
BJ L	15,456	18,674	28,763
Business Jet Total	28,620	31,123	44,251
GA Itinerant Total	53,229	54,272	69,198
GA - Local	15,682	15,477	16,669
Military	100	100	100
Total All Operations	199,742	202,556	242,739

Notes:

SEL = Single engine piston
MEL = Multi engine piston
TP = Turboprop
BJ = Business jet

S = Small (under 44,000 lbs)
L= Large (44,000-300,000 lbs)

Source: SH&E Forecast.

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Regional Airport System Plan Update – *Mid-Point Screening Report*

Prepared for:

Regional Airport Planning Committee

Prepared by:

SH&E, Inc.
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July 26, 2010

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1 Study Background and Screening Analysis Summary

1.1 Study Background and Introduction

The overall goals of the Regional Aviation System Planning Update (RASP Study) are to determine when the Bay Area's primary commercial airports— Oakland International (OAK), San Francisco International (SFO), and San Jose International (SJC)—will reach their capacity limits, and to identify strategies other than new runway construction that will be most effective in allowing the region to accommodate future growth in aviation demand.

The RASP Study has forecast that passenger demand to and from the Bay Area's commercial airports will grow from 61 million passengers in 2007 up to approximately 101 million passengers (Base Case) in 2035. Based on this unconstrained demand forecast, it is expected that San Francisco International Airport will reach its runway capacity limits (assuming current Air Traffic Control procedures) sometime after 2020, and that by 2035 the airport will experience severe levels of aircraft delays. Oakland and San Jose are both projected to have available capacity over the forecast horizon and could handle an increased share of the region's demand.

The Screening Analysis described in this report evaluates the effectiveness of six specific strategies for accommodating the region's future demand. The Scenarios have been defined with input from the Regional Airport Planning Committee (RAPC), the Task Force, and two technical advisory panels. The six scenarios are:

- Redistribution of Traffic Among The Primary Airports
- New Airline Service at Secondary Bay Area Airports
- New Airline Service at Airports Outside the Bay Area
- High-Speed Rail in the California Corridor
- Demand Management Strategies
- New Air Traffic Control Technologies

In the Screening Analysis these strategies are evaluated individually to identify the potential benefits provided by each. Based on the results of this initial screening and public input, the strategies will be combined into two or three scenarios for final analysis.

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While an overall study goal is to identify strategies for accommodating the Bay Area's future air passenger demand, the airports are integral to the region's economic activity and they impose impacts on the environment and on people who live nearby. Any future plans for the region's airport system are likely to involve tradeoffs between the various goals. To identify and assess these potential trade-offs, seven goals have been established for the scenario screening analysis:

- **Reliable Runways -** *Can we reduce flight delays and passenger inconvenience?*
- **Healthy Economy -** *Can the region serve future aviation demand and support a healthy economy?*
- **Good Passenger Service -** *Can we provide better service to the region's major air travel markets?*
- **Convenient Airports -** *Can we maintain or improve airport ground access times and travel distances?*
- **Climate Protection -** *Can we decrease Greenhouse Gas (GHGs) emissions from aircraft and air passengers traveling to airports?*
- **Clean Air -** *Can we decrease air pollution from aircraft and air passengers traveling to airports?*
- **Livable Communities** - *Can we avoid increasing the regional population exposed to aircraft noise?*

1.2 SUMMARY OF SCREENING ANALYSIS RESULTS

The Air Traffic Control Scenario is the only scenario that effectively reduces future aircraft delays at SFO to acceptable levels. While the ATC Scenario rates the highest in terms of aircraft delay reduction, Redistribution, High-Speed Rail and Demand Management also provide meaningful delay reduction benefits. High-Speed Rail is the best performing scenario for the passenger service and environmental goals. However, the environmental benefits are modest compared to the delay reduction benefits. The Internal and External Airports Scenarios provide little in the way of aircraft delay reduction, but they do reduce passenger ground access times by providing greater flight choices closer to the passenger's ground origin (or destination).

2 ALTERNATIVE SCENARIOS

2.1 INTRODUCTION

This section describes how the six alternative scenarios are defined. The Regional Airport Planning Committee (RAPC), the Task Force, and three technical advisory panels provided input for structuring each of the scenarios:

- Redistribution of Traffic Among the Primary Airports
- New Airline Service at Secondary Bay Area Airports
- New Airline Service at Airports Outside the Bay Area
- High-Speed Rail in the California Corridor
- Demand Management Strategies
- New Air Traffic Control (ATC) Technologies

For the mid-point screening analysis, the scenarios were evaluated individually to identify the potential benefits provided by each alternative. Based on the results of the mid-point screening analysis and public input, the individual strategies will be combined into two or three scenarios for final analysis in the next stage of the study.

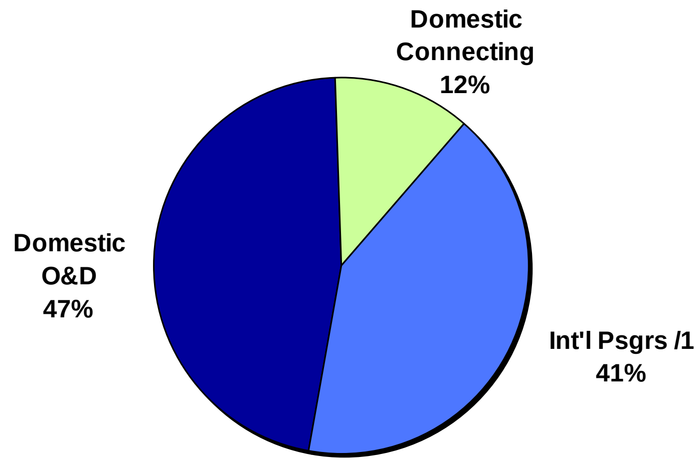
2.2 ALTERNATIVE SCENARIOS DEFINED

2.2.1 Redistribution of Traffic Among the Primary Airports

If new ATC technologies and/or demand management could not successfully mitigate the high levels of delay forecasted for SFO in 2035, it is likely that some traffic would naturally shift from SFO to the other primary airports. The "Redistribution Scenario" specifically examines the impacts of such a shift.

Since SFO functions as a major international gateway and a connecting hub for United Airlines, domestic O&D passengers are the most likely to shift. Domestic origin-destination (O&D) passengers are passengers that travel to and from the Bay Area to other markets in the U.S. In 2035, domestic O&D passengers are forecast to account for 47 percent of SFO's total airport passengers. (See Exhibit 2-1)

Exhibit 2-1 – Forecast 2035 SFO Passenger Traffic by Market Segment



/1 Includes domestic to international connecting passengers

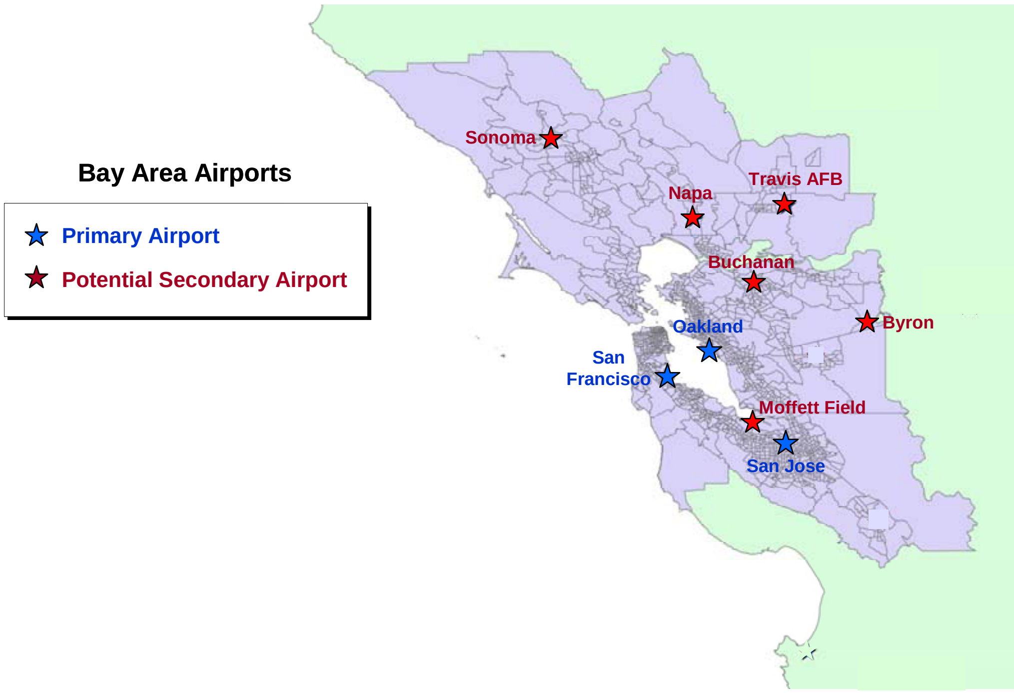
Source: RAPC, Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, by SH&E, August 27, 2009

This scenario assumes that the build-up of delays at SFO will encourage a shift of demand to OAK and SJC through natural market forces and without any direct intervention. Excessive delays at SFO will increase the cost of using SFO for both airlines and passengers and create natural incentives for airlines and passengers to make greater use of available capacity at OAK and SJC. The extent of traffic redistribution will depend largely on airline decisions to expand services at competitive fares at OAK and SJC. However, airline decisions will be driven by profit expectations and not by a desire to fully accommodate future Bay Area passenger demand.

2.2.2 New Airline Service at Secondary Bay Area Airports

The "Internal Secondary Airports Scenario" assumes that some air passenger demand can be served at smaller, secondary airports in the 9-county Bay Area region. (See Exhibit 2-2) All the secondary airports in the region including federal facilities such as Moffett Federal Airfield (operated by NASA) and Travis Air Force Base were assessed for their potential to support commercial air passenger services using a matrix of evaluation factors. The central question answered by this scenario is "What is the potential of secondary Bay Area airports to support air passenger services and provide relief to the primary airports?" It specifically identifies secondary Bay Area airports that might support future scheduled passenger airline services and quantifies the level of future passengers that could be diverted from the primary airports and the corresponding reduction in aircraft operations.

Exhibit 2-2 - Potential Internal Secondary Airports



The success of this scenario is dependent upon the airlines' willingness to introduce competitive services at the secondary airports. An airline's decision to enter a secondary airport market will be based on several considerations including: the inability to grow or serve its passenger base from the primary airports because of capacity constraints; potential passenger demand at the secondary airports, specifically the ability to expand its Bay Area market share through incremental passenger growth rather than simply diverting passengers from one airport to another; the market's strategic fit with the airline's business strategy; the availability of aircraft properly sized for the market; and the costs of opening and staffing a new station.

Regional efforts to increase the utilization of secondary airports proved useful in the Boston metropolitan area, when Southwest Airlines entered the T.F. Green Airport in Providence and the Manchester Airport in New Hampshire in the late 1990s. As a result of Southwest's entry and a competitive response from other airlines, T.F. Green and Manchester were able to significantly increase their share of Boston area passengers from 11 percent in 1995 to 27 percent in 2005. However, in the current airline operating environment with widespread LCC market presence and other cost pressures (i.e., rising fuel prices) airlines have been reducing capacity at smaller markets and have withdrawn services from many. More recent attempts at

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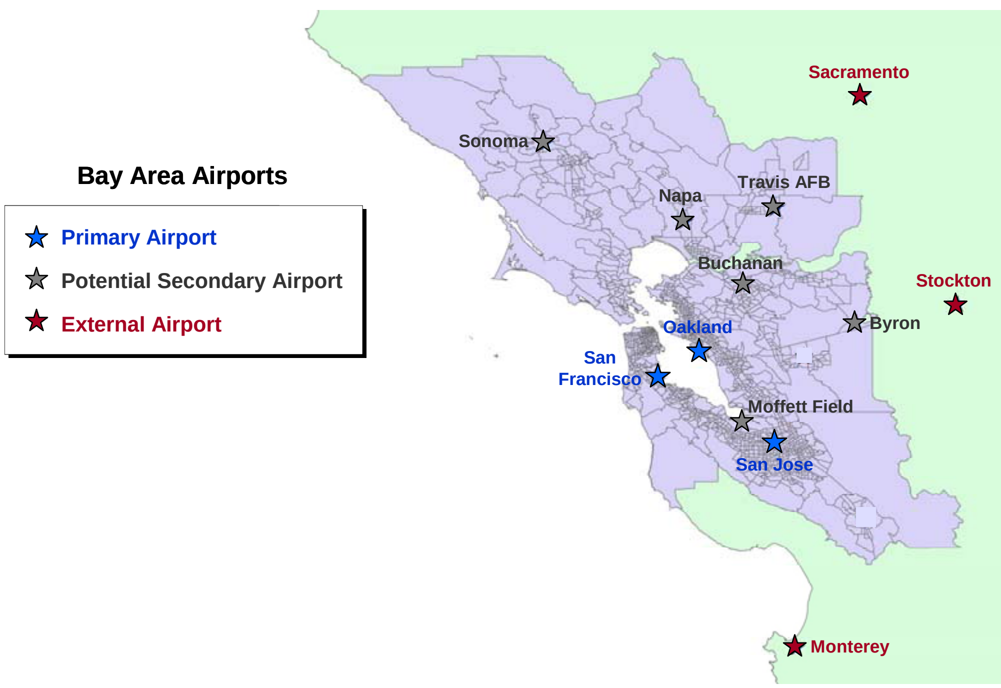
regionalization such as the Port Authority of New York and New Jersey's efforts to increase airline services at Stewart Airport have been met with mixed results.

2.2.3 New Airline Service at Airports Outside the Bay Area

In 2006, about 9 percent of domestic air passengers using one of the primary airports originated from outside the 9-county Bay Area region. These passengers were attracted to the Bay Area airports either because of higher levels of air service or lower air fares compared to airports in the neighboring regions. (See Exhibit 2-3). In this "External Secondary Airports Scenario", three airports – Sacramento International Airport (SMF), Monterey Peninsula Airport (MRY) and Stockton Metropolitan Airport (SCK) – were evaluated to assess the future ability of these airports to recapture local passengers who currently bypass these airports and instead choose to fly from a Bay Area airport.

Exhibit 2-3 - Potential External Airports



These external airports vary widely in their size and air service levels. Sacramento International Airport, which is served with 144 daily scheduled airline departures to 31 destinations (May 2010), accommodated 10 million passengers in 2008. The Monterey Peninsula Airport served 427,000 passengers in 2008 and receives 17 daily departures to 6 destinations (May 2010). Stockton Airport, the smallest of the three, only receives air services from Allegiant Airlines. It currently is served by Allegiant with one daily roundtrip flight each to Las Vegas and Long Beach. In 2008, when Allegiant was only serving Las Vegas from Stockton, approximately 27,000 passengers used the airport.

As airlines expand air service offerings at these airports over time, passengers from outside the region are expected to become less dependent on Bay Area airports for air service. The External Secondary Airports Scenario estimates the degree to which service development at the external airports can reduce demand for services at the Primary Bay Area airports. As in the Internal Secondary Airports Scenario, the effectiveness of this scenario depends on the airlines' interest in developing new air service at these airports and local marketing efforts.

2.2.4 High-Speed Rail in the California Corridor

The "High-Speed Rail Scenario" assesses the potential future diversion of air passengers from the Bay Area airports to the planned California high-speed rail (HSR) system. The initial phase of the 220-mph HSR, which has received partial funding from state and federal sources, would be constructed between downtown San Francisco and Los Angeles/Anaheim and could potentially serve air passengers who would normally fly from the Bay Area to Los Angeles, Burbank, Orange County, and beyond to Ontario. (See Exhibit 2-4) The initial HSR system would indirectly serve passengers in the Bay Area-San Diego and Ontario markets who could connect to the HSR service using conventional train service or automobiles. In a subsequent phase, the HSR will be extended from Los Angeles to San Diego, with better access to Ontario, potentially diverting more air passengers in the Bay Area-San Diego and Ontario markets.

Over 100 trains per day would travel between the Bay Area and Southern California in 2035 with a travel time to Los Angeles of about 2.5 hours. The planned HSR alignment enters San Jose from the south and travels up the Peninsula to downtown San Francisco. The California cities that would be served by HSR include 5 of the top 15 domestic air passenger markets and 26% of all domestic passengers served from the three Bay Area airports (based on 2007 passenger statistics). Air passengers would be diverted to HSR by a combination of factors, such as frequent service, competitive fares, reliability, and proximity to their final destination.

Exhibit 2-4 – Planned HSR in the California Corridor

2.2.5 Demand Management Strategies

The "Demand Management Scenario" analyzes the use of administrative measures to reduce projected aircraft delays in the Bay Area airport system in 2035. Demand Management involves the use of regulatory or administrative measures to control of influence the number of aircraft flights at an airport.(See Exhibit 2-5) The most common form of demand management is the use of slot controls to limit the number of aircraft take-offs and landings to below an airport's hourly capacity. In the past, the FAA has imposed slot controls at highly congested airports, like New York La

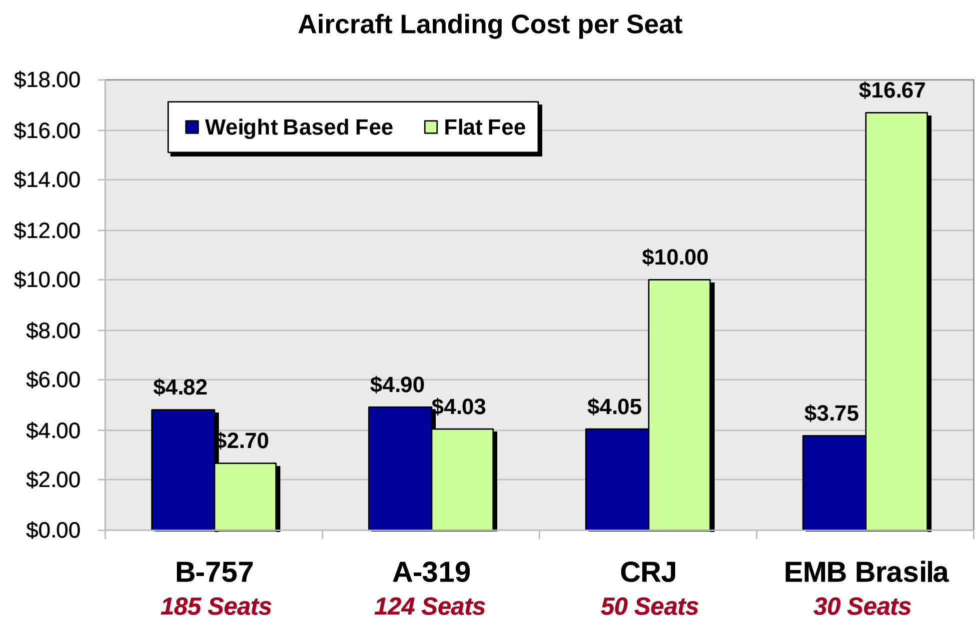
Guardia, Washington's National Reagan Airport, and New York JFK Airport, to manage delays.

Exhibit 2-5 -Potential Demand Management Measures

- **FAA Slot Controls** *(DCA/LGA)*
- **FAA Negotiated Caps** *(ORD/JFK/EWR)*
- **Perimeter Rules** *(LGA/DCA/Love Field)*
- **Passenger Caps** *(Orange County)*
- **Direct Negotiations Between the Airport and the Airlines**
- **Limits on Available Gates** *(LAX)*
- **Minimum Aircraft Size Rules**
- **Peak Period Pricing** *(BOS)*
  - *Explicitly Permitted at Congested Airports by New U.S. DOT Rates and Charges Policy*

More recently, new U.S. DOT policy allows certain "congested" airports to enact landing fees that are partly based on the level of congestion at the airport rather than based solely on the landing weight of aircraft. Administrative measures, such as differential pricing, can reduce congestion and delay by creating financial incentives for airlines to: (1) spread flight activity more evenly across the day, and (2) increase aircraft size (i.e., encourage up-gauging) to accommodate more passengers with fewer fights. (See Exhibit 2-6)

Exhibit 2-6– A Flat Landing Fee Provides a Financial Incentive for Using Larger Aircraft



Note: Weight based fee assumes cost per seat at $4.50 per 1,000 lbs. Flat fee assumes cost per operation of $500.

Source: Jane's All World's Aircraft, OAG

For the screening analysis, the focus of the Demand Management Scenario is not to define a specific program, but rather to estimate the potential capacity and delay benefits that demand management could produce in the Bay Area. Since SFO is the only highly congested airport in the 2035 Base Case forecast, the Demand Management Scenario evaluates the impact of demand management strategies at reducing delays SFO. The emphasis is on reducing the number of small aircraft (i.e., 50- to 70-seat Regional Jets, 30-seat turboprops and business jets) during peak operating times, which include the period when SFO is most susceptible to weather delays caused by morning fog.

2.2.6 New Air Traffic Control Technologies

The "Air Traffic Control (ATC) Scenario" analyzes the potential impacts of technical advancements in the FAA's air traffic control system on the projected delays at the Bay Area Airports. NexGen, the FAA's next generation air traffic management system, will be based on satellites for precise navigation as well as other technologies and will significantly improve airspace and runway capacity in the United States.

Major elements of NexGen that would improve airport capacity include technologies to reduce the spacing between aircraft landing and taking off at airports[1]; new departure and arrival routes to remove existing bottlenecks in the airspace; expanded weather conditions in which pilots can essentially fly their planes as if they were operating in good weather; improved sequencing of arriving aircraft to optimize arrival capacity, and improved navigation precision so that aircraft arrive over fixed points at specific times. (See Exhibit 2-7)

Exhibit 2-7 – NexGen Technologies and Procedures

Improvement	New Technology/Procedure
Reduce Required Aircraft Separations	**Wake Vortex Advisory System (WVAS)** **Airport Surface Detection Equipment (ASDE-X)**
Increase Precision of Aircraft Tracking	**Required Navigational Performance (RNP)** **Increase precision of ATC spacing of aircraft** **Center-TRACON Automation System (CTAS)**
Extend Weather Envelope When Procedures Can be Used	**Enhanced Simultaneous Offset Instrument Approach (SOIA)** **Cockpit Display of Traffic Information Assisted Visual Separation (CAVS)** **IFR Paired Approaches**

[1] For safety reasons separations between arriving and departing aircraft are required so that a trailing aircraft can avoid the wake turbulence created by the leading aircraft.

The new ATC technologies will enhance capacity at all Bay Area airports, but SFO is expected to be the major beneficiary. SFO is forecast to have severe delays by 2035, and the newer technologies could overcome some of the limitations imposed by weather patterns unique to SFO and the close spacing of its runways.

The ATC Scenario is based on a specific set of assumptions regarding technologies and the timing of when they are deployed. However there are a number of barriers to full implementation of the new ATC technologies. First, new ATC technologies typically take at least a decade for FAA certification and user acceptance. Airlines and other users may still be reluctant to pay for new equipment unless they can clearly see the economic benefits. In addition, pilots and controllers must undergo training and must accept the new systems as completely safe. Political pressure will likely be needed to accelerate deployment of key technologies for the Bay Area such as reduced separations and paired approaches during IFR conditions.

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IMPACTS OF SCENARIOS ON AIRPORTS

3.1 INTRODUCTION

This section describes the impacts of each of the scenarios on airport operations or capacity over the forecast period. All of the scenarios, except ATC, will impact aircraft activity at the primary airports either by shifting demand to other airports or modes or up-gauging operations to larger size aircraft. ATC, on the other hand, increases airport capacity and can accommodate the forecast levels of aircraft activity with less delay. For each of the five scenarios that affect demand, the specific assumptions that drive the projection of aircraft operations are described and forecast aircraft operations are compared to the Baseline forecast. For the ATC Scenario, this section addresses how specific ATC technologies can improve capacity at each airport and summarizes average aircraft delays compared to the Baseline.

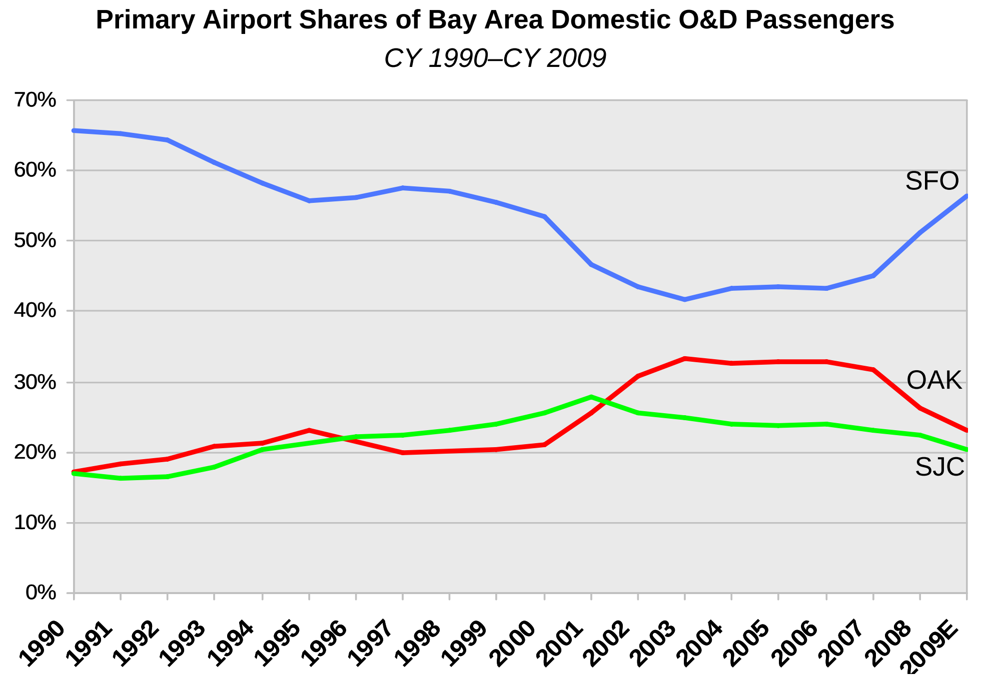
3.2 REDISTRIBUTION OF AIR PASSENGERS AMONG THE PRIMARY AIRPORTS

3.2.1 Background and Assumptions

In the 1990s, SFO was one of the most heavily delayed airports in the nation. The delay situation and operating costs at SFO contributed to airline decisions to expand Bay Area air services at OAK and SJC. As airlines concentrated their growth at OAK and SJC, these airports accounted for an increasing share of the region's air traffic. OAK's share of Bay Area domestic O&D passengers grew from approximately 20 percent in the latter part of the 1990s to a peak of 33 percent in 2003. Similarly, SJC also gained market share over this period, but less dramatically than OAK. SJC's share of domestic O&D passenger rose from approximately 22 percent in 1995 to 28 percent in 2001. Market share growth at OAK and SJC occurred gradually, and lagged the onset of serious delays at SFO by several years.

However, recent developments in the airline industry and the Bay Area market have completely eroded the OAK and SJC market share gains. SFO's share of the region's domestic O&D passengers increased from approximately 43 percent in 2006 to an estimated 57 percent in 2009. (See Exhibit 3-1) While the low cost carrier (LCC) Southwest Airlines had expanded services rapidly at OAK and SJC during the 1990s and withdrew from SFO in March 2001, the pendulum began to shift as LCCs grew their presence at SFO starting in 2007. The dramatic growth in SFO's LCC services was triggered when Virgin America announced in 2005 that SFO would serve as its headquarters and principal base of operations. Prior to the Virgin America service launch in August 2007, jetBlue initiated service at SFO in May 2007. Also, Southwest Airlines reinstated services as SFO in August 2007 at about the same time that Virgin America services began.

Exhibit 3-1 – Recent Airline Industry Developments have Completely Eroded the Market Share Gains Made by OAK and SJC

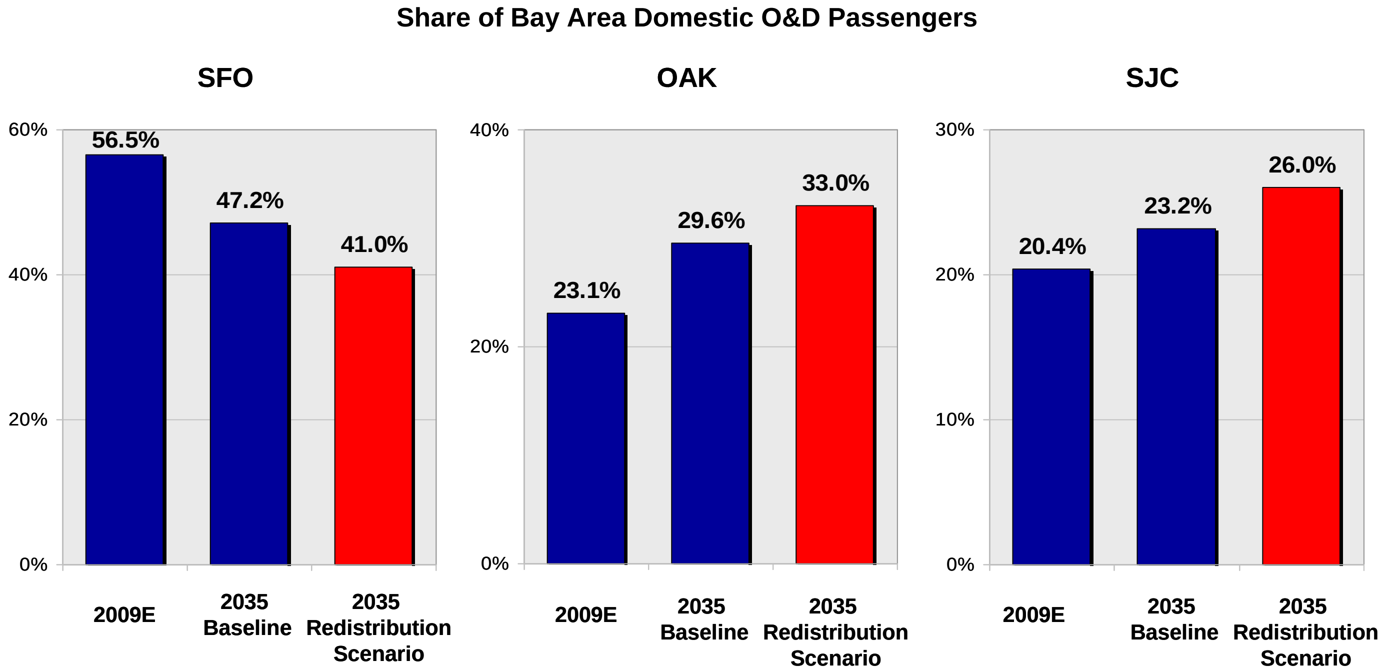


Source: ACI-NA Airport Traffic Statistics, Airport Data and US DOT O&D Passengers Survey.

Rapidly rising fuel prices in 2008 and the global recession of 2008-2009 furthered the concentration of services and air traffic at SFO. The run-up in fuel prices and shrinking passenger demand led airlines to sharply curtail capacity and consolidate services. American Airlines and Continental Airlines both closed their stations at OAK and leading carriers, Southwest and Alaska Airlines dramatically cut back their service schedules at OAK. Carriers including American, Alaska and United, also curtailed services at SJC.

This scenario assumes that a future redistribution of traffic among the Bay Area airports will largely mirror what has happened in the past. The excessive congestion and delays forecast at SFO are expected to lead to higher costs for both airlines and passengers and as a result, growth at SFO will slow. The Redistribution Scenario explicitly assumes that by 2035 both OAK and SJC return to their historic peak shares of Bay Area domestic local traffic: OAK's peak historic share was 33 percent and SJC's was 26 percent[2]. In this scenario SFO's domestic local passenger share would fall from an estimated 57 percent in 2009 to 41 percent in 2035. Exhibit 3-2 compares the airport share assumptions for the 2035 Baseline and the 2035 Redistribution Scenario. The scenario assumes that only domestic O&D passengers shift and that long-haul international passengers will continue to be served from the SFO gateway.

Exhibit 3-2– The Redistribution Scenario Assumes a Meaningful Shift in Domestic O&D Passengers from SFO to OAK and SJC



E – estimated

3.2.2 Forecast Airport Activity

Airport Passengers

The Redistribution Scenario reduces SFO passenger demand from 64M to 60M in 2035, shifting approximately 4M passengers to OAK and SJC. Passenger traffic at OAK increases by 11.6 percent from 20.7M to 23.1M. At SJC, passenger traffic is projected to increase from 16.3M to 18.2M. (See Exhibit 3-3)

---

[2] SJC's actual peak domestic O&D passenger share was 27 percent in 2001, but that year was excluded due to the impacts of 9-11. In 2000 and 2002, SJC accounted for approximately 26 percent of the region's domestic local traffic.

Exhibit 3-3 – In the Redistribution Scenario 4M Passengers Shift from SFO to OAK and SJC

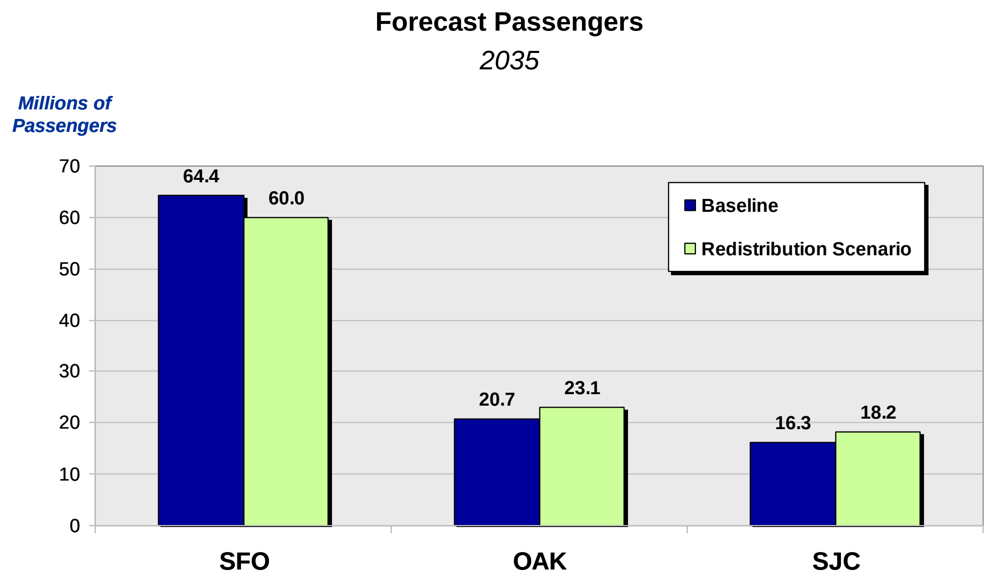
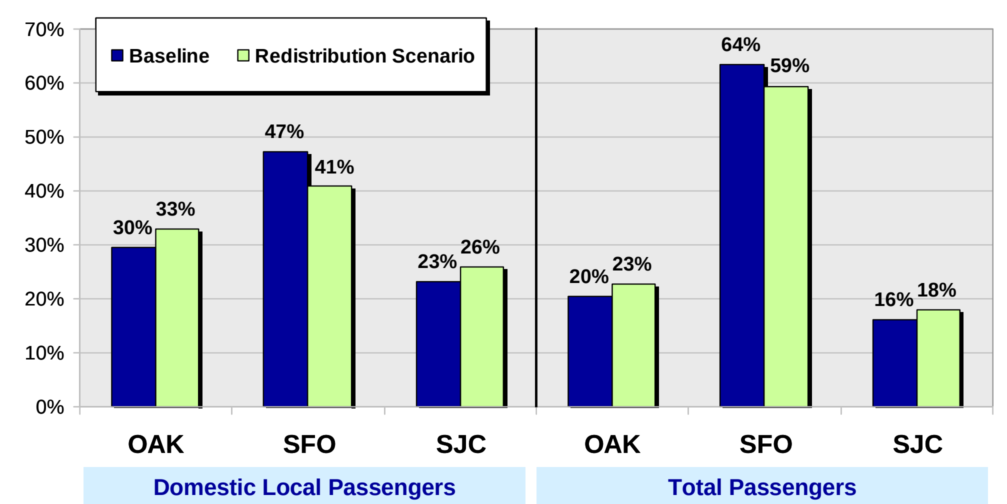


Exhibit 3-4 summarizes the resulting airport shares for total Bay Area traffic including international and connecting passengers. SFO's share of total Bay Area passengers (domestic O&D, international O&D, and connecting) falls from 64 percent in the Baseline to 59 percent in the Redistribution Scenario.

Exhibit 3-4 – SFO's Share of Total Passengers at the Primary Airports is Forecast to Fall from 64% to 59% in the Redistribution Scenario



Aircraft Operations

Under the Redistribution Scenario aircraft operations at SFO in 2035 are forecast at 489,000 compared to 527,000 for the Baseline. (See Exhibit 3-5) Total aircraft operations at the combined airports increase slightly over the Baseline from 1.124M to 1.127M, because the average aircraft size for domestic services is lower at OAK and SJC than at SFO.

Exhibit 3-5 – Comparison of Forecast Passengers and Aircraft Operations at the Primary Airports, *Baseline vs. Redistribution Scenario*

Year and Scenario	Passengers OAK	Passengers SFO	Passengers SJC	Passengers Total	Operations OAK	Operations SFO	Operations SJC	Operations Total
Base Year 2007	14,616,594	35,317,241	10,658,389	60,592,224	337,295	373,015	199,742	910,052
Foreast 2020:								
Baseline	16,332,161	46,124,417	12,850,537	75,307,115	301,091	431,172	202,556	934,819
Redistribution	16,332,161	46,124,417	12,850,537	75,307,115	301,091	431,172	202,556	934,819
Percent Change	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Foreast 2035:								
Baseline	20,655,297	64,356,302	16,305,371	101,316,970	354,945	526,595	242,739	1,124,279
Redistribution	23,058,533	60,032,533	18,225,904	101,316,970	377,392	489,258	260,783	1,127,433
Percent Change	11.6%	-6.7%	11.8%	0.0%	6.3%	-7.1%	7.4%	0.3%

3.3 New Airline Service at Secondary Bay Area Airports

3.3.1 Background and Assumptions

Potential Secondary Airports

RAPC and the Task Force evaluated nine secondary airports in the Bay Area region, including military airfields, to identify the best candidates for future air service and their ability to relieve the primary airports:

- Byron Airport
- Buchanan Field Airport (Concord)
- Gnoss Field Airport (Novato)
- Half Moon Bay Airport
- Livermore Municipal Airport
- Moffett Federal Airfield
- Napa County Airport
- Sonoma County Airport
- Travis AFB

The specific criteria used by RAPC and the Task Force to screen the secondary airports and identify the best airports for inclusion in the Internal Secondary Airports Scenario were:

- A prior history of air service;
- The airport has been identified as a candidate for service in another study or transportation plan;
- A catchment area with sufficient air passenger demand to support airline services;
- Air cargo market potential;
- Convenience as a GA reliever airport;
- Runway length capable of accommodating commercial airline aircraft;
- Available land for facilities;
- Airspace interactions with the primary airports or other airports;
- Ground access infrastructure;
- Policies or other factors that may limit activity;
- Existence of significant environmental issues (i.e., noise, air quality or physical environ)
- Land use compatibility;
- Safety of operations; and
- Potential for sea level rise.

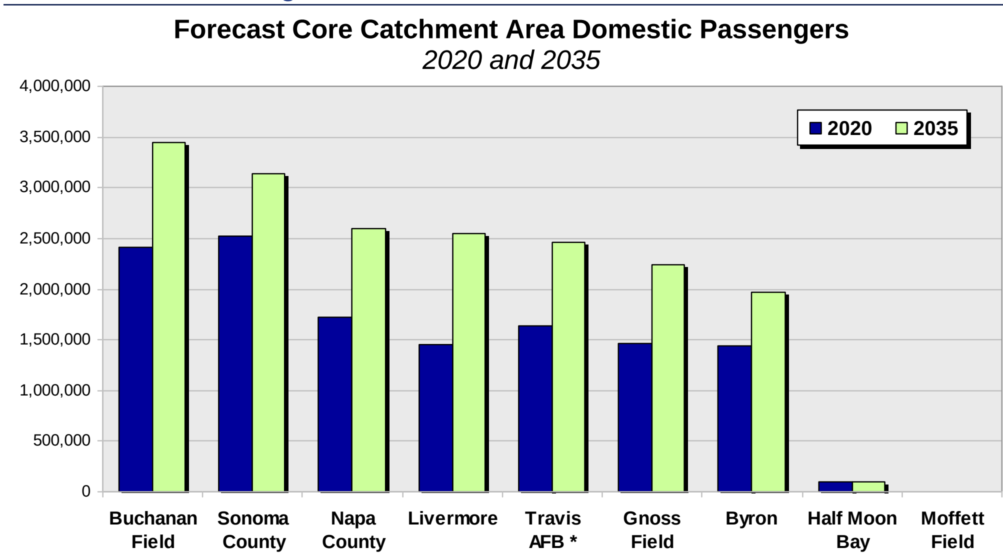
Estimated Airport Catchment Areas

The consultant team defined secondary airport catchment areas (i.e., the geographic area from which an airport's passengers originate) and estimated the base year and forecast passenger demand for each airport catchment area. The location of an alternative airport relative to the closest primary airport will be critical to its success in attracting air passengers. If an alternative airport is too close to SFO or OAK, it would be difficult for it to compete with the larger, better-served airport. On the other hand, if the secondary airport is too distant from the core Bay Area market, it could generate too few air trips to sustain air service. The level of passenger demand generated by a secondary airport's market area is essential to both its ability to attract airline service and its ability to provide meaningful relief to SFO/OAK.

Catchment areas were defined by analyzing drive times for each of MTC's 1,454 travel analysis Zones (TAZs) to each primary and secondary airport in the Bay Area and to Sacramento International Airport (SMF). Peak morning (6:00 am to 10:00 am) travel times to Bay Area airports were obtained from MTC's BayCast regional transportation network model for 2035. Travel times to SMF were estimated. If a TAZ was at least 30 minutes closer to a secondary airport than one of the primary airports (or SMF), it was assigned to the secondary airport's core catchment area.

Forecast passenger demand for the secondary airport catchment areas is shown in Exhibit 3-6. By 2035, most of the secondary airports are forecast to have at least 2 million domestic O&D passengers in their core catchment areas. Buchanan Field is forecast to have the largest core catchment area in 2035 with 3.4 million domestic O&D passengers followed by Sonoma County with 3.1 million. The 2035 catchment area demand for Travis is forecast at 2.5 million domestic passengers. This is strictly based on future air passengers that would otherwise use one of the Bay Area airports. However, because of its location, Travis could potentially serve passengers from the Bay Area that currently use Sacramento International Airport. If these passengers were included, it is estimated that the total size of the Travis catchment area would be approximately 3.4 million[3]. Two airports, Half Moon Bay and Moffett, have none or insignificant demand in their core catchment areas because of their proximity to one of the primary airports.

Exhibit 3-6 – By 2035, Several of the Secondary Airports are Forecast to have More than 2M Passengers in Their Core Catchment Areas



Notes:

Includes forecast passengers that would use a primary Bay Area airport. Excludes passengers that may use Sacramento International Airport. Includes catchment area overlap among the airports.

* Demand in the Travis catchment area would increase to approximately 2.1M in 2020 and 3.4M in 2035 if estimated passengers using SMF are included.

[3] Sacramento Airport passenger data by ground origin was not available. The additional passengers in the Travis catchment area were estimated by assuming that 50 percent of air passengers in Solano County use a Bay Area airport and 50 percent use SMF.

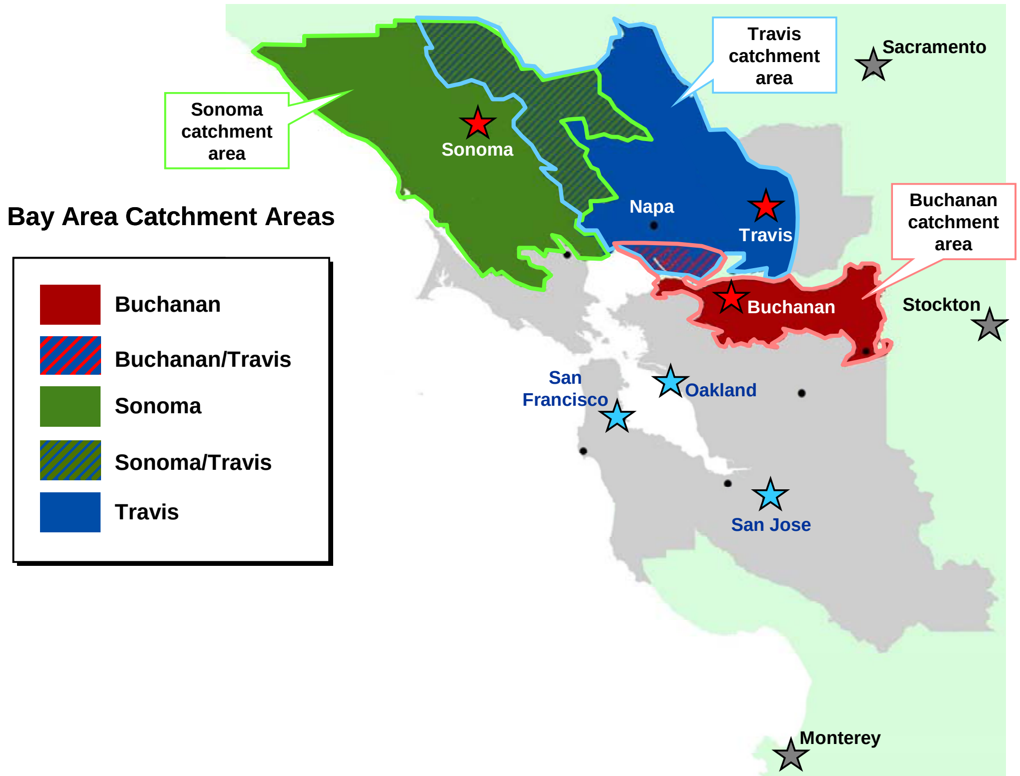
Secondary Airport Selection

Based on the multiple screening criteria, RAPC and the Task Force developed a short-list of three airports to carry forward in the Internal Secondary Airports Scenario: Buchanan, Sonoma County, and Travis. These airports are representative of the types of airports that could support air services and provide a measure of relief to SFO and OAK. Each of these airports has sufficient catchment area demand (i.e., at least 1.5 million domestic passengers); is not too close to a primary airport (i.e., a drive time of 30-minutes or more to the closest primary airport); and has adequate runway length (i.e., at least 5,000 feet). They have the greatest potential and likelihood of developing future air services, but they do not preclude the development of air services at other airports in the region.

Of the three airports carried forward in the Internal Secondary Airports Scenario, Buchannan has the largest forecast catchment area, with forecast demand of 3.4 million passengers in 2035, and it previously supported scheduled airline services. However, its proximity to OAK (37 minutes) could potentially limit its ability to attract airline services and passengers. Sonoma County Airport, currently receives scheduled passenger services from Horizon Airlines, an affiliate of Alaska Airlines. Travis has a 2035 catchment area demand forecast of 2.5 million passengers and it accommodated airline services in the 1970s through a joint use agreement between the County and the U.S. Air Force. In addition, Travis has ample airside capacity with 11,000 foot runways.

Exhibit 3-7 depicts the catchment areas for each of the three airports in the Internal Secondary Airports Scenario.

Exhibit 3-7 – Core Catchment Areas for Sonoma, Travis and Buchanan Airports



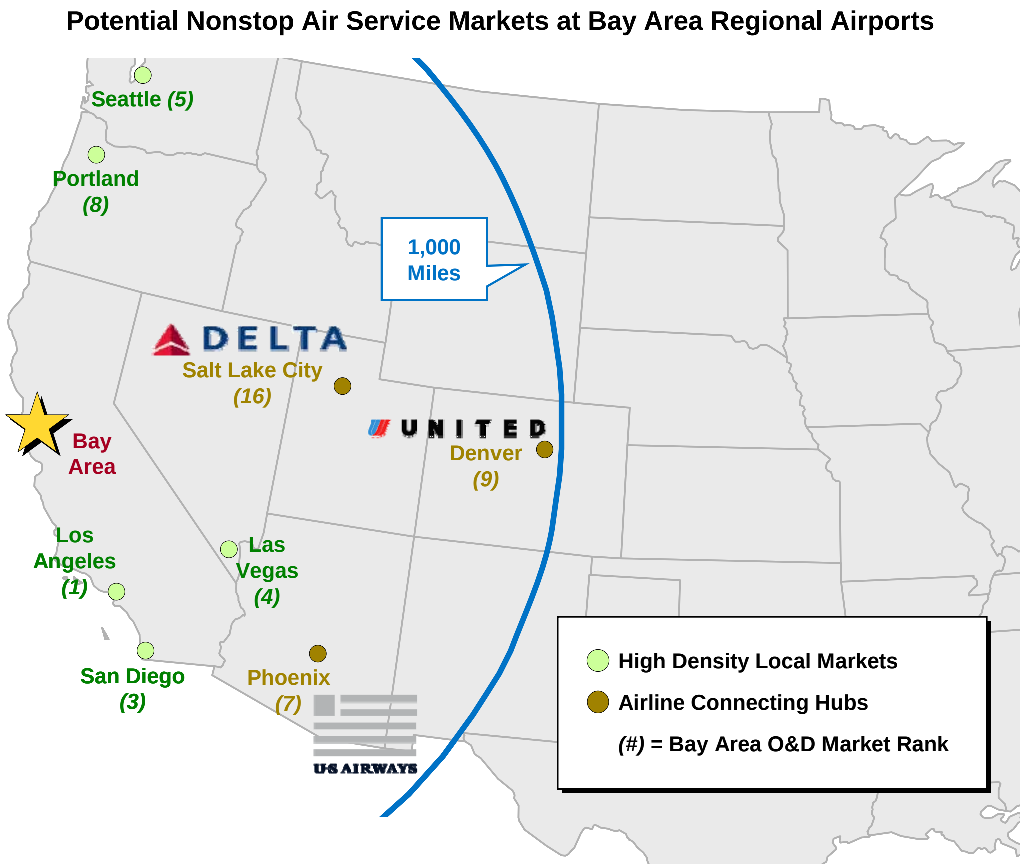
Together the catchment areas of the three airports are forecast to generate 8.5 million domestic air passengers (including some overlap) that would use the SFO (4.0M) or OAK (4.5M) airports in 2035[4] The passengers generated in the Buchanan/Sonoma/Travis catchment areas account for 24 percent of OAK's forecast domestic local passengers in 2035 and 13.4 percent of SFO's domestic local passengers.

4 Approximately 0.2M passengers from the Buchanan, Sonoma or Travis catchment areas are forecast to use SJC in 2035. Includes overlap between the catchment areas.

Secondary Airport Air Service Assumptions

The Internal Secondary Airports Scenario assumes that if the alternative airports were served by commercial passenger airlines, they would most likely attract services to high-density, short-haul markets and nearby airline connecting hubs. The top short-haul domestic markets for the Bay Area and airline connecting hubs that are within 1,000 miles are shown in Exhibit 3-8.

Exhibit 3-8 - Types of Air Service Markets that Might be Served from the Secondary Airports



The Internal Secondary Airports Scenario assesses the potential for each of the alternative airports to divert air passengers from the primary airports by estimating the level of air services to these short-haul markets that each could support. Next, the annual passengers diverted were translated into reductions in aircraft operations at the primary airports to assess the impact on delays, access and environmental targets.

The first step in determining the amount of air services that each airport might support was to estimate air passenger demand in the potential air service markets from each of the three secondary airports in 2020 and 2035. The secondary airports were assumed to have the same distribution of domestic O&D passengers as the overall Bay Area region. Applying this assumption to each airport's catchment area demand provided forecast passenger demand by O&D market.

Since Sonoma County Airport currently receives scheduled airline services, its experience was used to estimate each airport's potential catchment area penetration rate. In October 2009, Horizon Airlines served Sonoma County Airport with 5 daily departures to west coast destinations: Seattle (1 daily departure), Portland (1 daily departure), Las Vegas (1 daily departure) and Los Angeles (2 daily departures). For CY 2008, the air services at Sonoma County Airport were estimated to have captured approximately 42 percent of its core catchment area passenger demand in its nonstop air service markets. (See Exhibit 3-9)

Exhibit 3-9 – Sonoma County Airport Captured an Estimated 42% of its Core Catchment Area Demand in Nonstop Markets in 2008

Sonoma County Airport's Estimated Catchment Area Capture Rate

2008

2008 Rank \1	Market	O&D Psgrs \2		Core Catchment Area Psgrs \3	Capture Rate
1	Los Angeles	77,927		177,864	43.8%
4	Las Vegas	38,415	\4	122,528	31.4%
5	Seattle	46,747		104,905	44.6%
12	Portland	31,978		60,670	52.7%
	Total Nonstop Markets	**195,067**		**465,967**	**41.9%**
	Total All Markets	217,035	\4	2,109,052	10.3%

Notes: \1 Based on domestic O&D market distribution for the primary Bay Area airports.
\2 US, DOT O&D Survey passengers scaled to actual enplaned/deplaned passengers reported by Sonoma County Airport.
\3 Core catchment area includes passengers from all ground zones (TAZs) that are closer to Sonoma County Airport (STS) and at least 30 minutes closer to STS than the closest primary Bay Area Airport (or SMF). Includes existing STS passengers.
\4 Annualized to reflect a full year of Las Vegas service, which was initiated in May 2008.

For the forecast years, it was assumed that services at the secondary airports could capture 50 percent of catchment area demand in 2020 and 60 percent in 2035. Other major service assumptions included the type of aircraft and its seating capacity, the amount of on-board connecting passengers (i.e., passengers connecting at the destination airport to reach their ultimate destination), and an average load factor for sustainable service.

All services at the secondary airports were assumed to be operated with large turboprop or regional jet (RJ) aircraft with an average seating capacity of 70-seats. Examples of such aircraft are the Bombardier Q-400 turboprop, which Horizon Airlines uses to serve the Sonoma County Airport as well as large 70-seat RJs such as the Canadair CRJ-700 and the Embraer -170. (See Exhibit 3-10)

Exhibit 3-10– Aircraft Types Likely to Serve Secondary Airports

The percentage of connecting passengers on-board each flight was estimated based on the experience of similar services. The connecting percentages for the high-density short-haul markets were based on Horizon's experience at Sonoma County Airport. The connecting ratio for airline connecting hub markets was based on airline experience in the Bakersfield, Fresno, Monterey, San Luis Obispo and Santa Barbara markets. Exhibit 3-11 summarizes the local/connecting mix assumptions for each destination market.

Exhibit 3-11 – Local and Connecting Traffic Mix Assumptions for the Secondary Airport Services

Nonstop Market	Local	Connecting
High Density		
Los Angeles	95%	5%
San Diego	100%	0%
Las Vegas	100%	0%
Seattle	80%	20%
Portland	80%	20%
Connecting Hub		
Phoenix	25%	75%
Denver	25%	75%
Salt Lake City	25%	75%

Services were assumed to be feasible if they could support load factors of at least 75 percent. Based on all the service assumptions, the secondary airports were projected to have sufficient demand to support services to 5 high-density markets and 2 airline connecting hubs by 2035. (See Exhibit 3-12) The services for Sonoma County exclude normal growth in passengers already using the airport and only include the services that would attract newly diverted passengers. The services for Travis are based solely on passenger demand that would use one of the primary Bay Area airports and excludes potential passengers that may use SMF. If SMF passenger demand were included, the services at Travis could support higher load factors or more flight frequencies.

Exhibit 3-12 – Forecast Air Service Levels at the Secondary Airports

Year	Airport	No. of Local Markets	No. of Hubs
2020	Sonoma County	5	1
	Buchanan	4	1
	Travis	4	1
2035	All	5	2

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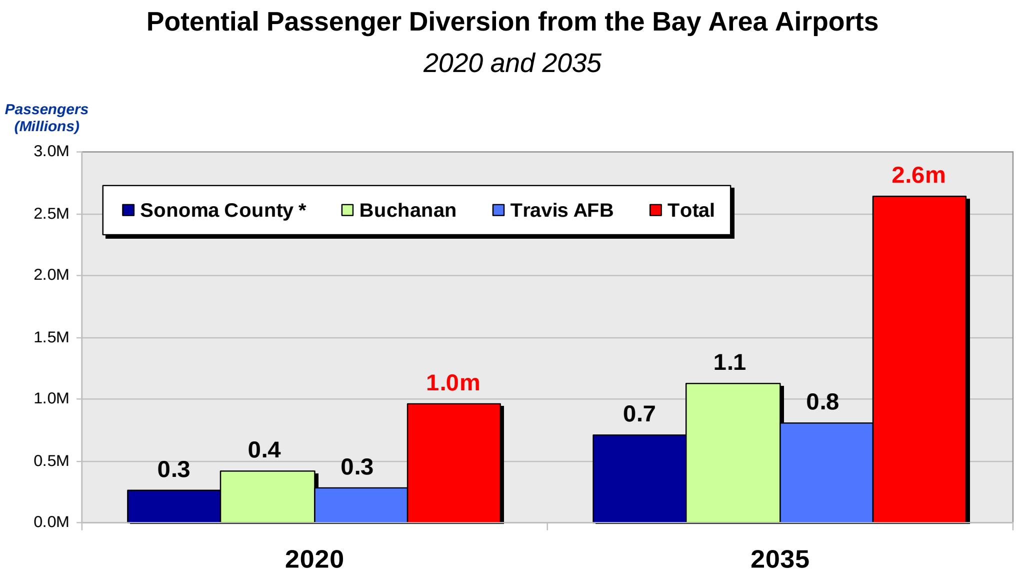
3.3.2 Forecast Airport Activity

Airport Passengers

In the Internal Secondary Airports Scenario, the three alternative airports are estimated to divert a combined 1.0 million passengers in 2020 increasing to 2.6 million passengers in 2035. (See Exhibit 3-13) The estimated diversion in 2035 represents a 2.6 percent reduction in passengers at the primary airports. More than half of the passengers, almost 1.4 million, are diverted from OAK, 1.2 million are diverted from SFO, and 57,000 are diverted from SJC. Buchanan Air Field accounts fort 1.1 million of the estimated 2035 diversion, compared to 0.8 million for Travis and 0.7 million for Sonoma County.

Exhibit 3-13 – Under the Internal Secondary Airports Scenario, 2.6M Passengers Shift from the Primary Airports to the Secondary Airports in 2035



* Forecast passenger diversion for Sonoma County Airport includes newly diverted passengers and excludes passengers already using the airport. With normal growth in existing Sonoma County services and the introduction of new air services, the Sonoma County Airport would accommodate approximately one million passengers in 2035.

Aircraft Operations

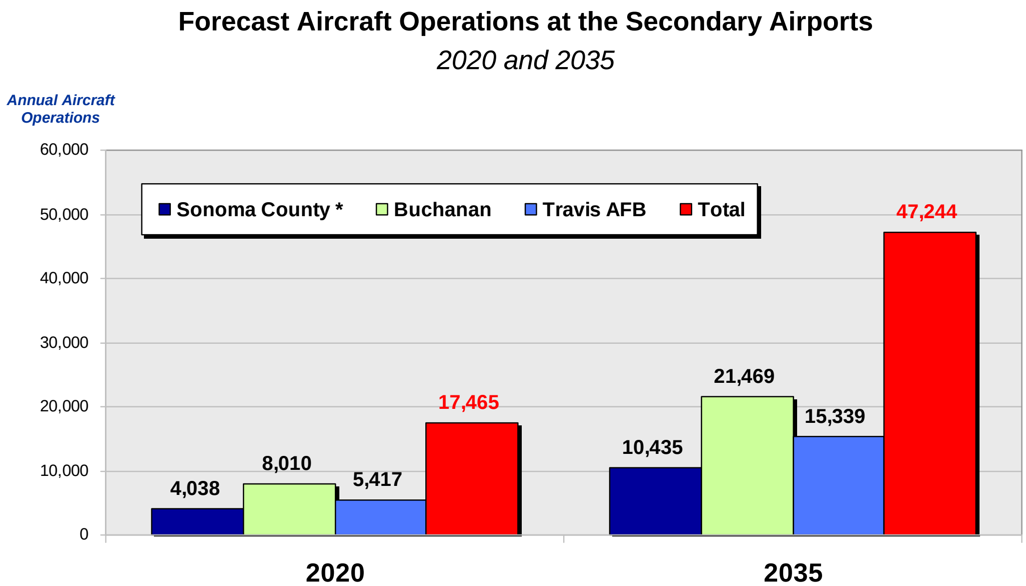
The diversion of passengers to secondary airports reduces annual aircraft operations at the primary airports by 24,000 or approximately 2.1 percent. In the Internal Secondary Airports Scenario, aircraft operations at SFO in 2035 are forecast at 516,000 (including passenger, all-cargo and GA operations), about 2 percent lower than the Baseline level of 527,000. Aircraft operations at OAK fall by 3.6 percent from 355,000 to 342,000. (See Exhibit 3-14).

The estimated new services at the secondary airports results in 47,000 aircraft operations at the secondary airports, for a net increase in region-wide aircraft activity of 23,000 operations. Total region-wide operations increase because the services introduced at the secondary airports are flown with smaller capacity aircraft than the average aircraft in use at the primary airports. (See Exhibit 3-15)

Exhibit 3-14 – Comparison of Forecast Passengers and Aircraft Operations at the Primary Airports, *Baseline vs. Internal Secondary Airports Scenario*

	Passengers				Operations			
Year and Scenario	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Base Year 2007	14,616,594	35,317,241	10,658,389	60,592,224	337,295	373,015	199,742	910,052
Foreast 2020:								
Baseline	16,332,161	46,124,417	12,850,537	75,307,115	301,091	431,172	202,556	934,819
Internal Airports	15,837,734	45,676,795	12,829,465	74,343,994	296,202	426,806	202,343	925,352
Percent Change	-3.0%	-1.0%	-0.2%	-1.3%	-1.6%	-1.0%	-0.1%	-1.0%
Foreast 2035:								
Baseline	20,655,297	64,356,302	16,305,371	101,316,970	354,945	526,595	242,739	1,124,279
Internal Airports	19,281,767	63,148,887	16,248,723	98,679,377	342,114	516,164	242,207	1,100,485
Percent Change	-6.6%	-1.9%	-0.3%	-2.6%	-3.6%	-2.0%	-0.2%	-2.1%

Exhibit 3-15 – In the Internal Airports Scenario, Aircraft Operations at the Secondary Airports are Forecast to Increase by 47,000 in 2035



3.4 New Airline Services at Airports Outside the Region

3.4.1 Background and Assumptions

The primary airports are used not only by passengers from the 9-county Bay Area region and connecting passengers, but also by passengers from outside the region that drive to one of the Bay Area airports for air service. In 2006, about 9 percent of the domestic passengers at the Bay Area airports originated from outside the region. These passengers chose to fly from one of the Bay Area airports rather than airports in the surrounding region for a number of reasons including better air services (e.g., more nonstop flights, more flight frequencies, more airline choices, etc.) and better airfares.

There are three airports in the surrounding area – Sacramento International Airport (SMF) to the northeast, Stockton Municipal Airport (SCK) to the east, and Monterey Peninsula Airport (MRY) to the south. As air services at these airports develop further over the forecast period, the number of passengers from outside the region that use a Bay Area Airport will decline over the forecast period. The External Airports Scenario estimates the amount of passengers that these airports can recapture from the Bay Area airports over the forecast period based on reasonable air service development.

The estimates of passenger recapture were based on data and studies collected from each of the external airports. The airports provided a range of data and studies including market demand studies, passenger leakage analyses, air passenger surveys, airport forecasts, and air service development targets. These data provided the basis for forecasts of new nonstop services at the external airports and estimates of how many passengers the new services could recapture from the primary Bay Area airports. Projections of recaptured passengers were then translated into corresponding reductions in aircraft operations at the Bay Area airports.

The specific approach to estimating passenger recapture varies for each external airport because of differences in available data and studies. The following sections describe the Bay Area passenger recapture estimates for each airport.

3.4.2 Sacramento International Airport

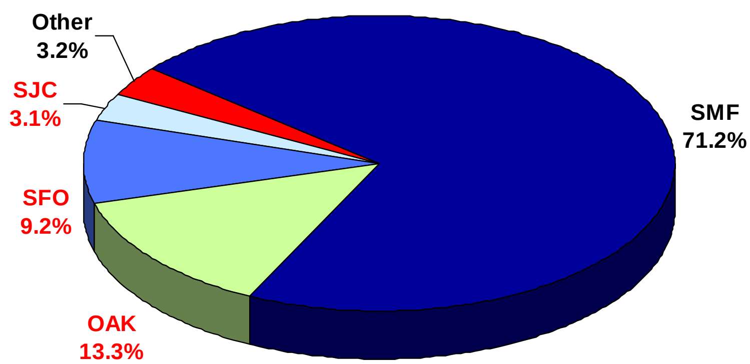
Sacramento International Airport (SMF) is the largest of the three external airports. In 2008 it accommodated approximately 10 million passengers (enplaned plus deplaned). In May 2010, airlines provided 144 daily departures to 31 destinations. Southwest Airlines is the leading carrier at the airport, providing approximately 57 percent of scheduled daily seat capacity in May 2010.

According to a passenger leakage study prepared for the Sacramento Airport, 26 percent of passengers originating in the SMF catchment area drive to the Bay Area for air service. (See Exhibit 3-16) Approximately half of the passengers traveling to the Bay Area for air service utilized OAK.

Exhibit 3-16 – One out of Four Passengers from the Sacramento Airport Catchment Area Drive to a Bay Area Airport for Air Service

Airports Used by Passengers Originating in the Sacramento Catchment Area

2005



Note: Based on 17-county primary and secondary air service areas.

Source: Sabre, Sacramento International Airport Catchment Area Analysis, May 2005.

The same study identified underserved markets, primarily in the eastern U.S. and Canada. Based on forecast passenger demand for the Sacramento catchment area, it is estimated that SMF can support 19 daily departures to 8 new domestic air service markets in 2020. By 2035, SMF could support a total of 34 daily departures to ten new transcontinental and transborder markets. (See Exhibit 3-17) With these new services, SMF could potentially recapture 323,000 passengers that would have otherwise used Bay Area airports in 2020, and 612,000 could be recaptured in 2035. More than half of the passengers recaptured would be from OAK.

Exhibit 3-17 - Over the Forecast Period, Sacramento Could Support 19 to 34 Daily Nonstop Departures in New Nonstop Markets

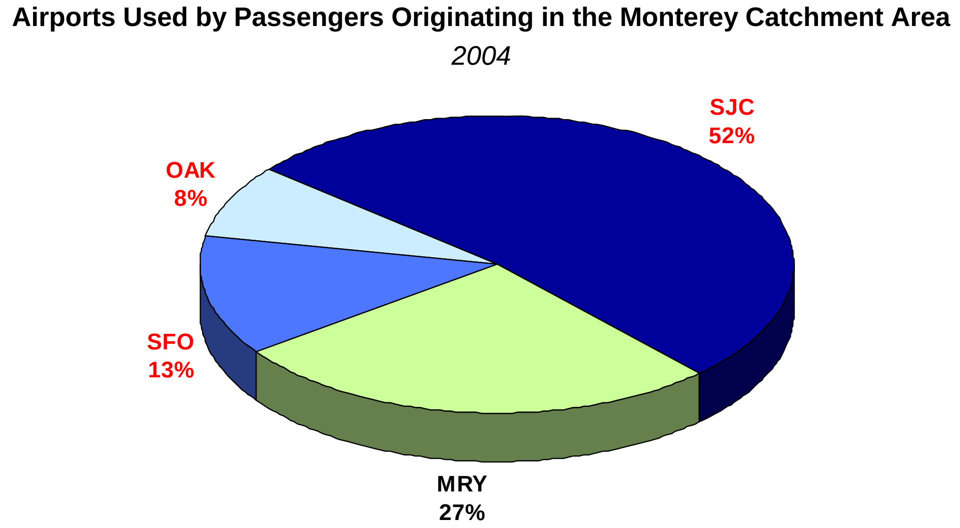
Market	SMF Daily Nonstop Departures 2020	SMF Daily Nonstop Departures 2035
Boston	3	4
Philadelphia	5	8
Orlando	2	4
Baltimore	2	3
Detroit	2	3
Kahului	1	2
St. Louis	2	4
New York Newark	1	2
Cancun	-	1
Vancouver	-	3
Toronto	-	-
Calgary	-	-
Total	**19**	**34**

3.4.3 Monterey Peninsula Airport

Monterey Peninsula Airport served 427,000 passengers (enplaning plus deplaning) in 2008. The airport receives nonstop air service from United Airlines, American, US Airways and Allegiant. In May 2010, they provided a total of 17 daily departures to 6 destinations including 6 daily departures to SFO.

The MRY catchment area is estimated at 1.6 million passengers in 2008. A leakage study conducted for the airport indicates that 73 percent of MRY area passengers use a Bay Area airport for air service. (See Exhibit 3-18) More than half of MRY's catchment area passengers (52 percent) use the SJC airport.

Exhibit 3-18 – 73% of MRY's Catchment Area Passengers Use a Bay Area Airport



Source: SH&E, Monterey Peninsula Airport Leakage Study, November 2004.

Air service development studies for MRY assume that future air service development at the airport will be focused on short-haul high density markets and airline connecting hubs. As in the internal airports analysis, these markets include Denver, Las Vegas, Los Angeles, Phoenix, Portland, Salt Lake City, San Diego, and Seattle. Based on forecast passenger demand in the airport catchment area, it is estimated that MRY could support 24 to 43 daily departures to these markets over the forecast period. (See Exhibit 3-19) While the Los Angeles, Phoenix, Denver, Las Vegas and San Diego markets are currently served from MRY, the airport could support higher service levels in 2020 and 2035.

Exhibit 3-19 – Monterey Could Support 24 to 42 Daily Nonstop Departures in the Markets Evaluated

		Existing Service (Nov. 2009)		Forecast Daily Departures		Forecast Daily Seats	
O&D Rank	Market	Average Daily Departures	Daily Seats	2020	2035	2020	2035
	New Nonstop Markets						
2	Portland	-	-	-	2.1	-	147
6	Salt Lake City	-	-	-	3.7	-	261
3	Seattle/Tacoma	-	-	-	3.2	-	222
	Expanded/Upgraded Service in Existing Markets						
5	Los Angeles	7.0	326	9.2	11.4	646	798
8	Phoenix	2.0	100	5.2	6.8	362	477
7	Denver	1.0	66	6.8	10.2	474	712
1	Las Vegas	0.3	50	1.5	2.7	104	190
4	San Diego	0.3	50	1.5	2.4	108	170
	Total	10.7	592	24.2	42.5	1,693	2,976

Note: 2020 and 2035 services assume 70-seat aircraft, a 75% load factor, and a minimum of 2 daily nonstops (except for LAS and SAN which are currently served with less than daily service).

The projected service levels at MRY would enable the airport to recapture 463,000 passengers from Bay Area airports in 2020 and 997,000 in 2035. Most of the recaptured passengers, 330,000 in 2020 and 710,000 in 2035, would come from SJC.

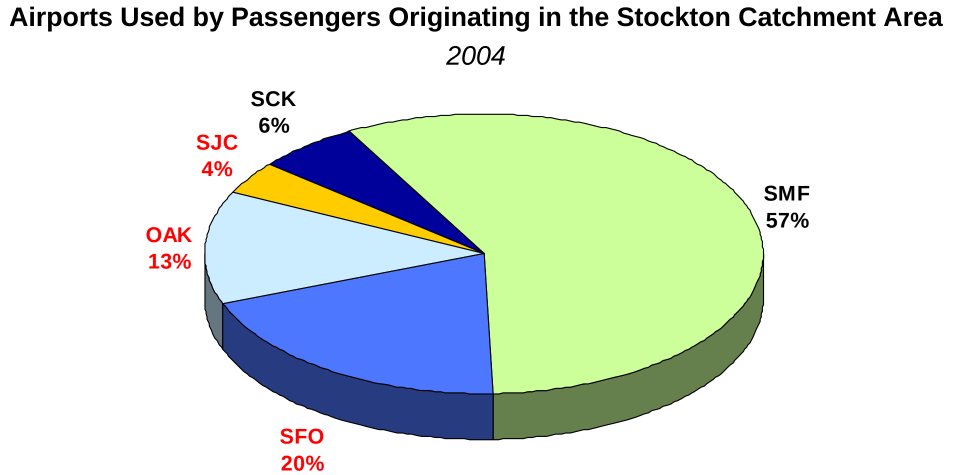
3.4.4 Stockton Metropolitan Airport

Stockton Metropolitan Airport (SCK), the smallest of the three external airports, had 59,000 commercial air passengers (enplaned plus deplaned) in 2008. In May 2010, Allegiant Airlines served the Stockton Airport with 3 weekly departures to Las Vegas.[5]

In 2007, SCK's catchment area included 890,000 air passengers. Because of its limited air services, only 6 percent of catchment area passengers use the Stockton airport. (See Exhibit 3-20) More than half of catchment area passengers (57 percent) use the Sacramento Airport for their air trips. The remaining 37 percent use one of the Bay Area airports, with 20 percent flying from SFO.

[5] Allegiant Air added nonstop service to Long Beach operated 5 times per week in June 2010.

Exhibit 3-20 - 37% of Stockton's Catchment Area Passengers Use a Bay Area Airport



Source: Stockton Metropolitan Airport, Draft Master Plan Update, October 12, 2009
California Regional Air Service Plan, Execution Plan Final Report Appendix A/B, May 30, 2007

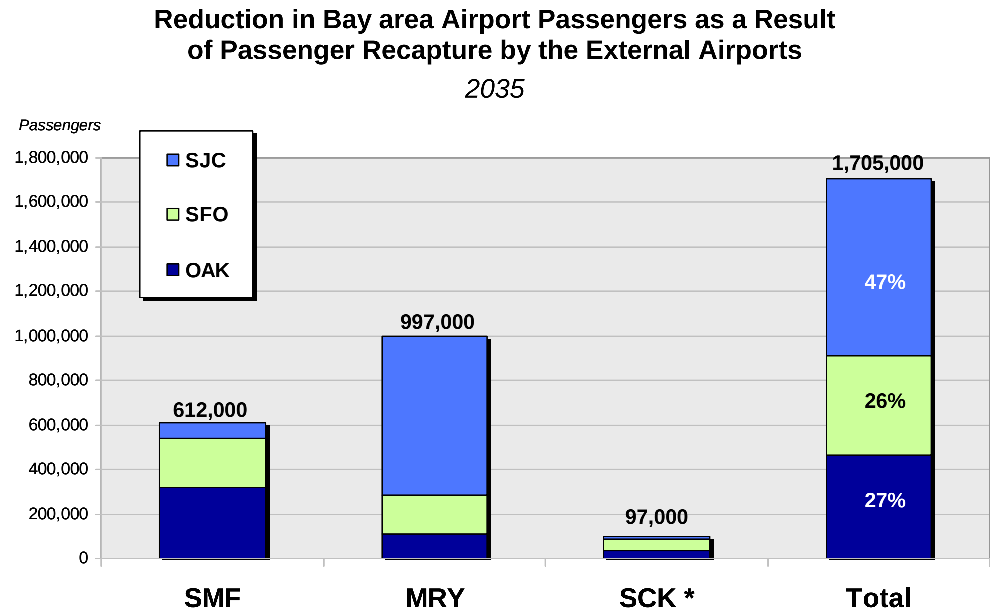
Bay Area passenger recapture estimates for Stockton were developed from the High Forecast Scenario in a draft version of the airport's Master Plan Update (October 12, 2009). The draft High Scenario forecast for Stockton assumed that, over the 20-year planning horizon, Stockton attracts services to additional destinations by Allegiant and/or mainline regional carriers to other markets in California and non-California airline hubs. Based on that forecast and the passenger leakage estimates, Stockton is projected to recapture 35,700 Bay Area passengers in 2020 and 96,700 Bay Area passengers in 2035.

3.4.5 Forecast Airport Activity

Airport Passengers

Service development at the External Airports is estimated to divert a combined 821,000 passengers in 2020 and 1.7 million in 2035. (See Exhibit 3-21) The estimated diversion in 2035 would reduce passengers at the primary airports by 1.7 percent. However, nearly half of the diverted passengers (47 percent) in 2035 come from SJC, which is not forecast to have a capacity problem in 2035. The remaining passenger diversion is almost equally divided between SFO and OAK.

Exhibit 3-21 –Passenger Recapture by the External Airports Could Reduce 2035 Passenger Demand at the Bay Area Airports by 1.7M



Aircraft Operations

The diversion of passengers to external airports reduces aircraft operations at the primary airports by 15,600 or approximately 1.4 percent. (See Exhibit 3-22) In the External Secondary Airports Scenario, aircraft operations at SFO in 2035 are forecast at 522,700, less than one percent lower than the Baseline level of 527,000. Aircraft operations at OAK fall by 1.2 percent, and SJC operations decrease by 3.1 percent.

Exhibit 3-22 – Comparison of Forecast Passengers and Aircraft Operations at the Primary Airports, *Baseline vs. External Secondary Airports Scenario*

	Passengers				Operations			
Year and Scenario	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Base Year 2007	14,616,594	35,317,241	10,658,389	60,592,224	337,295	373,015	199,742	910,052
Foreast 2020:								
Baseline	16,332,161	46,124,417	12,850,537	75,307,115	301,091	431,172	202,556	934,819
External Airports	16,101,025	45,906,838	12,478,209	74,486,072	298,806	429,050	198,803	926,659
Percent Change	-1.4%	-0.5%	-2.9%	-1.1%	-0.8%	-0.5%	-1.9%	-0.9%
Foreast 2035:								
Baseline	20,655,297	64,356,302	16,305,371	101,316,970	354,945	526,595	242,739	1,124,279
External Airports	20,193,628	63,906,969	15,511,482	99,612,079	350,632	522,713	235,290	1,108,636
Percent Change	-2.2%	-0.7%	-4.9%	-1.7%	-1.2%	-0.7%	-3.1%	-1.4%

3.5 HIGH-SPEED RAIL IN THE CALIFORNIA CORRIDOR

3.5.1 Background and Assumptions

The High-Speed Rail Scenario has the potential to reduce the number of passenger airline flights at each Bay Area airport compared to the Baseline Scenario as some intra-California air passengers select HSR over airline service due to factors such as closer proximity of train stations to their final destinations, lower train fares, train frequency, reliability of service, etc. The estimated diversion of air trips to HSR is based on the forecasts of future ridership on the planned California HSR system prepared for the California High-Speed Rail Authority (CHSRA) and the Metropolitan Transportation Commission by Cambridge Systematics, Inc. No independent estimates of potential HSR ridership were developed as part of this regional system plan update.

The most recent forecasts of future HSR ridership were released by the CHSRA in a report to the California Legislature in December 2009. These forecasts differed from earlier forecasts prepared in 2007 for the Metropolitan Transportation Commission and the CHSRA in three important respects: (1) the forecast ridership and associated revenue assumed implementation of the Initial Phase of the planned California HSR system rather than the full system on which the earlier forecasts were based; (2) the ridership forecasts were extended to 2035, rather than 2030 used in the earlier forecasts; and (3) the forecasts assumed that HSR fares would be set to 83 percent of the comparable airfares, rather than 50 percent assumed in the earlier forecasts.

The CHSRA and MTC forecasts of future HSR ridership were based on an inter-regional travel demand model that projected future inter-regional trips within California by four modes: automobile, air, conventional rail, and high-speed rail. By comparing the forecast number of air trips in the No-Build case (i.e., no HSR service available) in a given market with the corresponding forecast for a scenario that assumes some level of HSR service, the forecast percentage diversion of air travel to HSR in that market can be calculated. The market specific diversion rates were then applied to the demand forecast for intra-California air travel prepared this study. Since the HSR ridership forecasts of diverted air trips did not identify which airport those air passengers used, it was necessary to make assumptions about the way in which the overall diversion rate for the Bay Area as a whole varied across the three primary airports in the region, in order to derive airport specific diversion rates.

The forecast ridership by major market pairs is shown in Exhibit 3-23. Total forecast ridership in 2035 is 41 million passengers, of which 29.1 million, or 71 percent, are interregional trips. The largest single interregional market is between the Bay Area and the Los Angeles basin, which accounts for 7.9 million trips, or 19 percent of the total ridership. The market between the Bay Area and the San Diego region is projected to account for 2.0 million annual trips, or approximately 7 percent of the forecast interregional trips. During the Initial Phase of the planned system, HSR riders from the San Diego area would have to use a car or conventional rail service to access the Anaheim station. The remaining 11.9 million trips (or 29 percent) are local intra-regional trips within either the Bay Area or the Los Angeles basin.

Exhibit 3-23 Forecast HSR Ridership by Market, Initial Phase – 2035, Fares 83% of Airfares

Market Pairs	Forecast HSR Riders (millions)	Percent of Total
LA Basin - Bay Area	7.9	19.3%
San Joaquin Valley - LA Basin	6.3	15.4%
Bay Area - San Joaquin Valley	5.8	14.1%
Monterey Bay/Central Coast - LA Basin & Bay Area	2.9	7.1%
Within San Joaquin Valley	0.5	1.2%
Subtoal LA Basin - Bay Area & Intermediate Markets	*23.4*	57.1%
San Diego - Bay Area	2.0	4.9%
LA Basin - Sacramento	1.2	2.9%
Other Interregional	1.5	3.7%
North & Sierra regions - LA basin	0.5	1.2%
Sacramento - San Joaquin Valley	0.5	1.2%
Total Interregional	**29.1**	**71.0%**
Within LA Basin	7.9	19.3%
Within Bay Area Peninsula	4.0	9.8%
Total Intra-regional	**11.9**	**29.0%**
Total Ridership	**41.0**	**100.0%**

Source: CHSRA, Report to the Legislature, December 2009, Table C.

Air travel to and from the Bay Area airports includes trips from origins or to destinations in the Bay Area as well as trips that begin or end from external regions but use ground transportation to travel to or from the Bay Area airports. Two external regions - the Monterey Bay region (comprising Monterey, San Benito and Santa Cruz counties) and the North San Joaquin Valley region (San Joaquin, Stanislaus and Merced counties) - will both be served by HSR in the Initial Phase. In each case, the HSR stations will be significantly closer than any of the Bay Area airports. Therefore a significant portion of the trips from these regions that would otherwise use the Bay Area airports, due to limited local airport service to Southern California markets or lower airfares at Bay Area airports, are likely to also be diverted to HSR, resulting in fewer air passengers using the Bay Area airports.

The Bay Area air trips projected by the HSR ridership forecasts prepared for the CHSRA only include trips beginning or ending in the nine-county Bay Area.

Therefore to project the diversion to HSR of air trips using the Bay Area airports, it was necessary to combine the forecast air trips to and from the Bay Area with the air trips to and from external markets that use ground transportation to access one of the Bay Area airports or their final destination in the external region. The resulting diversion from air to high-speed rail by market is summarized in Exhibit 3-24. In 2035, the diversion rate is 60 percent for the Bay Area to the northern LA basin, which includes Los Angeles International Airports (LAX) and Burbank Airport (BUR). For the Bay Area to the southern LA basin (Long Beach and John Wayne/Orange County airports) approximately 47 percent of air trips are projected to be diverted to high-speed rail. The estimated air to rail diversion rate is the lowest, at 19 percent, in the Bay Area to San Diego, Ontario and Palm Springs markets, primarily due to longer access distances and need to connect to another transportation mode in the Initial Phase.

Exhibit 3-24 - Estimated Air-Rail Diversion by Market, Initial Phase

Market	Forecast Air-to-Rail Diversion 2020	2035
Bay Area to LA North (LAX, BUR)	19.8%	60.0%
Bay Area to LA South (LGB, SNA)	15.3%	47.0%
Bay Area to ONT, PSP, SAN	6.3%	19.0%

In addition to the diversion to HSR of air passengers to and from Southern California from the external regions who would otherwise connect at SFO, the analysis also assumes that air passengers from the Monterey Peninsula Airport or airports in the San Joaquin Valley who are connecting at SFO to or from flights in other markets could use the HSR system to travel to and from SFO, thereby reducing the number of passengers on the regional airline flights between those external airports and SFO.

An estimated 1.8 million passengers are diverted from air to rail in 2020 increasing to 6.1 million in 2035. (See Exhibit 3-25) In the Bay Area–LA Basin market, 5.2 millions air passengers are forecast to be diverted to high-speed rail in 2035 under the Initial Phase development with fares set at 83 percent of airfares. Diversion in the San Diego markets is estimated at 670,000. Without high-speed train service in the LA-San Diego corridor in the initial phase, passengers would have to access the Anaheim station by car or conventional train service. An additional 47,000 passengers are diverted in the Bay Area- Palm Springs market. Finally, approximately 194,000 passengers from the external regions that would have used air to connect to flights at SFO are projected to switch to HSR.

Exhibit 3-25 – Forecast HSR Diversion, Initial Phase – 2020 and 2035, Fares 83% of Airfares

Market	Airport Code	2020 Annual Trips	2020 Diversion	2020 HSR Trips	2035 Annual Trips	2035 Diversion	2035 HSR Trips
Los Angeles	LAX	3,689,785	19.8%	729,898	4,178,694	60.1%	2,510,450
Orange County	SNA	2,097,043	15.3%	320,804	2,469,276	46.5%	1,147,233
Burbank	BUR	1,734,436	19.8%	343,099	1,823,320	60.1%	1,095,403
Ontario	ONT	1,121,903	6.2%	69,526	1,080,862	18.8%	203,429
Long Beach	LGB	474,265	15.3%	72,553	550,002	46.5%	255,533
Subtotal LA Basin		9,117,432	16.8%	1,535,879	10,102,154	51.6%	5,212,048
San Diego	SAN	2,954,512	6.3%	184,799	3,557,524	18.8%	669,562
Palm Springs	PSP	208,046	6.3%	13,013	247,968	18.8%	46,670
Subtotal		**12,279,989**	**14.1%**	**1,733,691**	**13,907,646**	**42.6%**	**5,928,280**
Connecting at SFO							
Bakersfield	BFL	32,908	17.9%	5,899	42,639	54.4%	23,213
Fresno	FAT	103,612	17.9%	18,573	141,337	54.4%	76,946
Modesto	MOD	83,509	17.9%	14,970	106,580	54.4%	58,023
Monterey	MRY	100,534	9.0%	9,011	131,029	27.2%	35,667
Subtotal		**320,563**	**15.1%**	**48,452**	**421,585**	**46.0%**	**193,849**
Total		**12,600,552**	**14.1%**	**1,782,143**	**14,329,231**	**42.7%**	**6,122,128**

The HSR diversion forecast considers the Bay Area as a single region. Assumptions, shown in Exhibit 3-26, were made to estimate the diversion from each of the primary Bay Area airports to the southern California markets served by rail. HSR diversion rates for individual airport pairs were developed based on differences in the diversion rates between airports in the Bay Area as well as the relevant Southern California market diversion rate. It was assumed that airport pair markets involving BUR and LAX would experience the diversion rate for the North LA Basin market, while those involving SNA and LGB would experience the diversion rate for the South LA Basin market. Airport pair markets involving ONT and PSP were assumed to experience the same diversion rate as the San Diego market, due to the relatively long access distances to the HSR stations in the Initial Phase. It was further assumed that the diversion rates for OAK would be 75 percent of the corresponding diversion rates at SFO and SJC, due to the greater distance of the primary OAK market area from the planned HSR stations.

Exhibit 3-26 – Assumed Diversion to High-Speed Rail by Airport-Market Pair, Initial Phase – 2020 and 2035, Fares 83% of Airfares

		2020			2035		
Market		OAK	SFO	SJC	OAK	SFO	SJC
Los Angeles	LAX	16.3%	21.7%	21.7%	49.4%	65.8%	65.8%
Orange County	SNA	12.5%	16.7%	16.7%	38.1%	50.8%	50.8%
Burbank	BUR	16.7%	22.3%	22.3%	50.8%	67.7%	67.7%
Ontario	ONT	5.2%	7.0%	7.0%	15.9%	21.2%	21.2%
Long Beach	LGB	12.6%	16.8%	16.8%	38.2%	50.9%	50.9%
Palm Springs	PSP	4.8%	6.4%	6.4%	14.5%	19.3%	19.3%
San Diego	SAN	5.1%	6.8%	6.8%	15.3%	20.3%	20.3%

3.5.2 Forecast Airport Activity

Airport Passengers

The estimated diversion by Bay Area airport and market is shown in Exhibit 3-27. Of the total 6.1 million air trips that are diverted to high-speed rail in 2035, 2.4 million, or 39 percent, are diverted from SFO. SJC accounts for 32 percent of the diverted trips, or 1.9 million. The remaining 1.8 million diverted passengers would have otherwise flown from OAK.

Exhibit 3-27 - Forecast HSR Diversion, Initial Phase – 2020 and 2035, Fares 83% of Airfares

Market	Airport Code	Air Trips Diverted to HSR OAK	SFO	SJC	Total
2020					
Los Angeles	LAX	209,971	319,955	199,972	729,898
Orange County	SNA	89,404	112,194	119,206	320,804
Burbank	BUR	130,474	77,318	135,307	343,099
Ontario	ONT	26,440	15,668	27,419	69,526
Long Beach	LGB	20,871	27,828	23,853	72,553
Subtotal LA Basin		477,160	552,963	505,756	1,535,879
San Diego	SAN	44,951	79,913	59,935	184,799
Palm Springs	PSP	1,001	10,010	2,002	13,013
Subtotal		523,112	642,886	567,693	1,733,691
Connecting Passengers		0	48,452	0	48,452
Total		523,112	691,338	567,693	1,782,143
2035					
Los Angeles	LAX	722,184	1,100,471	687,794	2,510,450
Orange County	SNA	319,721	401,218	426,294	1,147,233
Burbank	BUR	416,562	246,851	431,990	1,095,403
Ontario	ONT	77,360	45,843	80,226	203,429
Long Beach	LGB	73,509	98,013	84,011	255,533
Subtotal LA Basin		1,609,336	1,892,396	1,710,315	5,212,048
San Diego	SAN	162,866	289,540	217,155	669,562
Palm Springs	PSP	3,590	35,900	7,180	46,670
Subtotal		1,775,793	2,217,837	1,934,650	5,928,280
Connecting Passengers		0	193,849	0	193,849
Total		1,775,793	2,411,685	1,934,650	6,122,128

Aircraft Operations

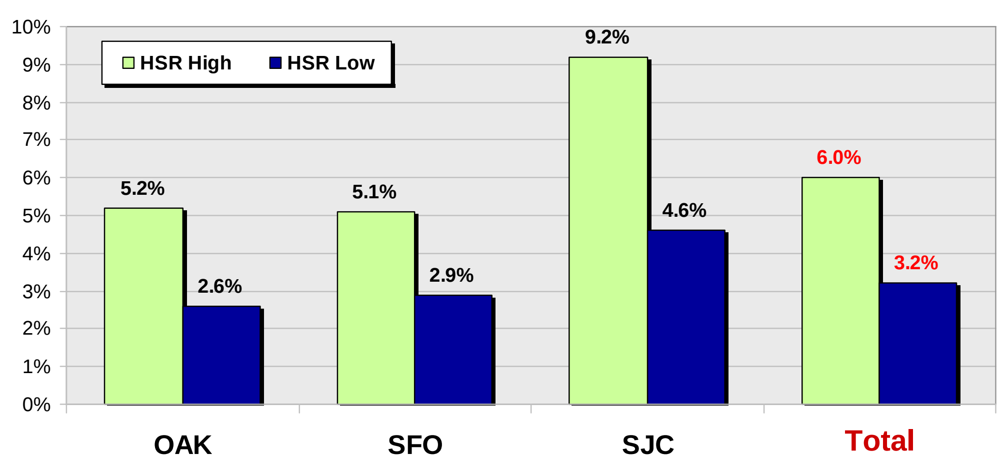
The diversion of passengers to high-speed rail reduces 2035 aircraft operations at the primary airports by 67,500 or approximately 6.0 percent. (See Exhibit 3-28) In the High-Speed Rail Scenario, aircraft operations at SFO in 2035 are forecast to decline by 5.1 percent to 499,900. Aircraft operations at OAK fall by 5.2 percent and SJC operations decrease by 9.2 percent. This forecast assumes that airlines continue to serve the Southern CA markets with small narrow body aircraft, such as the Boeing 737, similar to the types deployed in those markets in the 2007 base year.

Exhibit 3-28 Comparison of Forecast Passengers and Aircraft Operations at the Primary Airports, *Baseline vs. High-Speed Rail Scenario*

Year and Scenario	Passengers				Operations			
	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Base Year 2007	14,616,594	35,317,241	10,658,389	60,592,224	337,295	373,015	199,742	910,052
Foreast 2020:								
Baseline	16,332,161	46,124,417	12,850,537	75,307,115	301,091	431,172	202,556	934,819
High Speed Rail	15,809,049	45,433,078	12,282,844	73,524,972	295,323	421,502	195,498	912,323
Percent Change	-3.2%	-1.5%	-4.4%	-2.4%	-1.9%	-2.2%	-3.5%	-2.4%
Foreast 2035:								
Baseline	20,655,297	64,356,302	16,305,371	101,316,970	354,945	526,595	242,739	1,124,279
High Speed Rail	18,879,504	61,944,617	14,370,720	95,194,842	336,449	499,949	220,350	1,056,748
Percent Change	-8.6%	-3.7%	-11.9%	-6.0%	-5.2%	-5.1%	-9.2%	-6.0%

However, if airlines were to substitute smaller aircraft in some Southern CA markets, in order to maintain service frequency, the reduction in aircraft activity would be less. The average aircraft seats per operation in the Bay Area-Southern CA market in 2007 was 128. If the average seats per operations were to fall to 92 through the substitution of smaller aircraft in some Southern CA markets, high-speed rail would reduce total aircraft activity at the primary Bay Area airports by 3.2 percent. (Exhibit 3-29)

Exhibit 3-29 Percent Reduction in Annual Operations at the Primary Airports Resulting from Airline Substitution of Smaller Aircraft in the Bay Area-Southern CA Market, 2035



Sensitivity Analysis

A number of factors could result in a higher diversion of air passengers to HSR than the forecast prepared by the CHSRA. Future increases in fuel prices or other airline costs could lower HSR fares relative to airfares. Increasing levels of delay at the primary airports could make HSR a more dependable alternative. Travelers may value the comfort and ability to work while on the trains more so than the CHSRA forecast assumed. Finally, it is possible that the extension to San Diego may be operational by 2035.

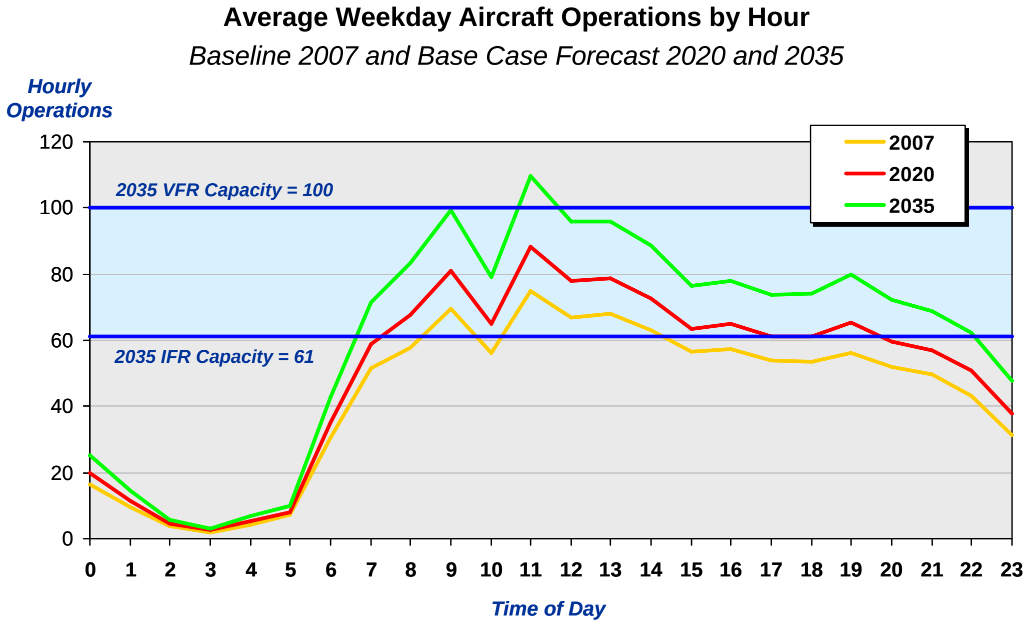
To assess the impact of a higher diversion rate, a sensitivity analysis was performed using an earlier CHSRA forecast which assumed that HSR fares would be 50 percent of the equivalent airfares. With this assumption, total diversion of air passengers to HSR in 2035 would increase from 6.1 million (assuming HSR fares are 83 percent of airfares) to 7.8 million. Aircraft operations at the primary airports would decline further from 1,057,000 (assuming HSR fares are 83 percent of airfares) to 1,048,000.

3.6 DEMAND MANAGEMENT

3.6.1 Background and Assumptions

The Demand Management Scenario assumes that demand management measures are only implemented at SFO, since it is the only airport that is projected to incur serious delays over the forecast period. Since hourly aircraft demand is not expected to exceed SFO's maximum VFR capacity until after 2020, demand management is only assumed for the 2035 forecast year. Demand Management is assumed to be in effect during the peak morning/early afternoon period from 8:00 am to 1:59 pm, when hourly activity is highest. (See Exhibit 3-30)

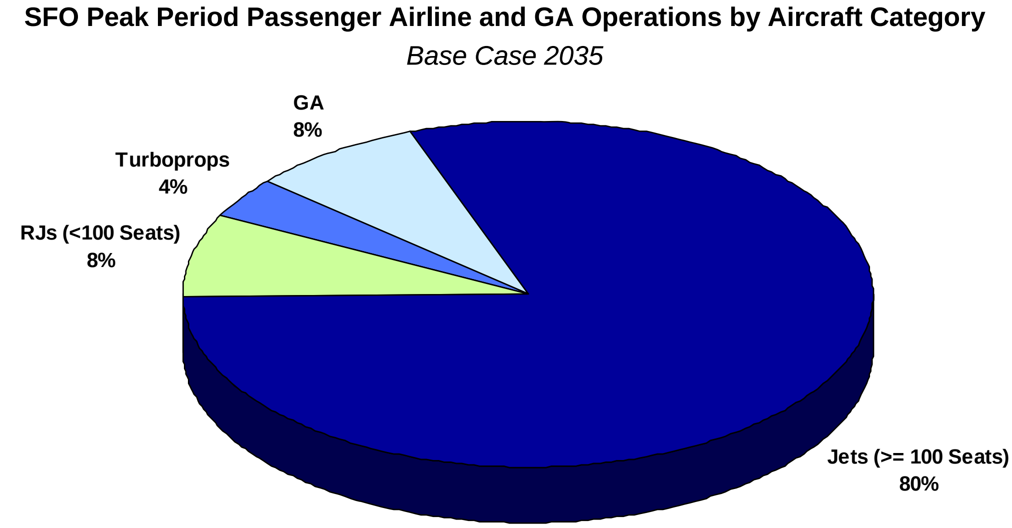
Exhibit 3-30 – By 2035, Late Morning Demand Will Exceed SFO's Maximum VFR Capacity and IFR Capacity Will Be Exceeded Throughout the Day



Source: Baseline Capacity Analysis

The Demand Management Scenario focuses on small aircraft operating in the peak period when poor weather conditions (i.e., fog) can significantly reduce SFO's hourly runway capacity. Since United Airlines operates a connecting hub at SFO and flies small aircraft from short-haul, small air service markets to SFO so that passengers may connect to other flights, small passenger aircraft accounted for 25 percent of SFO's operations but only 6 percent of passengers in 2007. Additionally, almost 75 percent of passengers traveling to SFO on small aircraft connect to another flight to reach their final destination. In the 2035 Base Case forecast, small passenger aircraft and GA operations are forecast to account for 20 percent of peak period aircraft demand. (See Exhibit 3-31)

Exhibit 3-31 – Small Aircaft Account for 20% of Forecast Operations at SFO in 2035



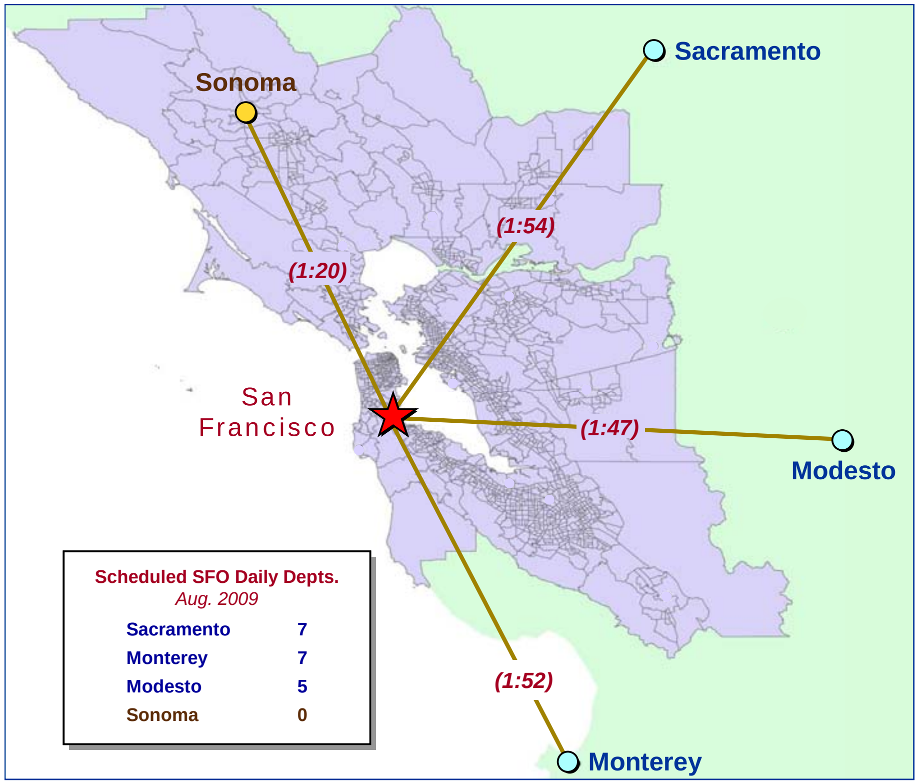
Note: Morning Peak period is defined as 08:00 to 13:59
Excludes all-cargo aircraft operations

Demand Management Assumptions

Passenger Airline Flights

The Demand Management Scenario assumes that frequent bus services to and from SFO are substituted for airline services in very close-in markets that are less than 100 air miles from SFO, or under a 2-hour drive. (See Exhibit 3-32) The markets that meet these criteria and currently receive scheduled airline service to SFO are Monterey, Modesto and Sacramento. The Demand Management Scenario assumes that passengers from these markets that need to fly from SFO could be efficiently served with frequently scheduled bus services the way that similar communities like Sonoma County, are served today. United Airlines operates 5 to 7 daily departures between these communities and SFO. All fights are flown with 30-seat Embraer Brasilia turboprops. In the 2035 Base Case forecast, Monterey, Modesto and Sacramento together account for 10 percent of the small aircraft operations during the peak period. However, the forecast assumes that airlines will no longer be operating the 30-seat turboprops in 2035 and instead these markets are assumed to be served with 70-seat turboprops.

Exhibit 3-32- The Demand Management Scenario Assumes Bus Substitution in Close-in Markets *(Drive Times to SFO)*



The Demand Management Scenario assumes that some combination of demand management measures (e.g., differential pricing policies, slot controls or other measures) would be implemented and would principally affect flights flown with turboprop and regional jet aircraft with fewer than 100 seats. Airlines are assumed to respond to demand management measures in two ways: (1) by shifting flights outside the peak period and (2) by substituting larger capacity aircraft (i.e., "up-gauging"). Aircraft up-gauging in markets that are served with frequent flights in smaller aircraft can reduce overall aircraft demand, by serving markets with larger aircraft and fewer flight frequencies.

Shifting flights to adjacent non-peak hours will help to smooth the demand profile at SFO. However, demand management's effectiveness in smoothing the demand profile across the day is limited. Airlines face a number of scheduling constraints that would prevent them from significantly retiming flights at SFO:

- As a connecting hub for United Airlines, United's flights at SFO are generally timed to meet connecting flight banks;

- Eastbound transcontinental flights must depart SFO before 3:00 P.M. in order to arrive at a reasonable hour on the east coast;
- Long-haul international flights are similarly timed to depart and arrive at reasonable hours; and
- Airlines must turn flights quickly to maintain high utilization and control costs.

The scenario assumes that some airlines may respond to the demand management measures by rescheduling small passenger aircraft flights (i.e., turboprops and RJs with less than 100 seats) during shoulder periods (i.e., 8:00-8:59 and 1:00-1:59) to adjacent hours. The scenario specifically assumes that 50 percent of small aircraft flights in the shoulder period are shifted to adjacent hours. The scenario also assumes that some airlines operating larger narrowbody jets (i.e., over 100 seats) may also respond to the demand management measures by rescheduling shoulder period flights. In this case, 20 percent of narrowbody jets during shoulder periods (8:00-8:59 and 1:00-1:59) are assumed to shift to adjacent hours. All small aircraft flights that are not shifted to non-peak hours remain in the peak period but are up-gauged to a jet aircraft with 100 seats.

General Aviation Flights

In addition to serving the needs of commercial airlines, SFO also accommodates general aviation (GA) aircraft operations. Corporate jets and business jet charters account for the majority of GA flying at SFO. The Demand Management Scenario assumes that SFO's general aviation flight activity can be limited by facilities management policies. For example, airport management can decide to not expand the airport facilities made available to GA users.

Specifically, the Demand Management Scenario assumes that GA operations are held constant at the 2007 level over the forecast period. Forecast growth in GA demand is instead assumed to be handled by nearby, smaller GA reliever airports in the Bay Area such as Half Moon Bay Airport, Gnoss Field or Livermore Municipal Airport.

The scenario also assumes that GA operations during the peak period could be limited through a slot reservation system in which GA users are required to obtain permission to operate unscheduled flights for a designated time period or "slot" (e.g., 9:00 to 9:59). The FAA requires slot reservations for unscheduled operations at New York LaGuardia, Washington Reagan National and Chicago O'Hare airports. In the Base Case forecast, GA demand is forecast at approximately 6 operations per hour. In the Demand Management Scenario, GA activity during the peak period is limited to 4 operations (2 arrivals and 2 departures) per hour. GA operations that can not be accommodated during the peak period are assumed to operate during the off-peak hours.

3.6.2 Forecast Airport Activity

Airport Passengers

The Demand Management Scenario assumes that all of the forecast passengers for SFO will be accommodated with: (1) forecast flights that are retimed to operate outside the peak period; (2) fewer operations in larger size aircraft; or (3) frequently scheduled bus service to and from three close-in communities. The number of passengers diverted to the bus mode in the Demand Management Scenario is 177,000 in 2035. (See Exhibit 3-33) The passenger diversion to bus mode in 2035 would reduce passengers at SFO by just 0.3 percent.

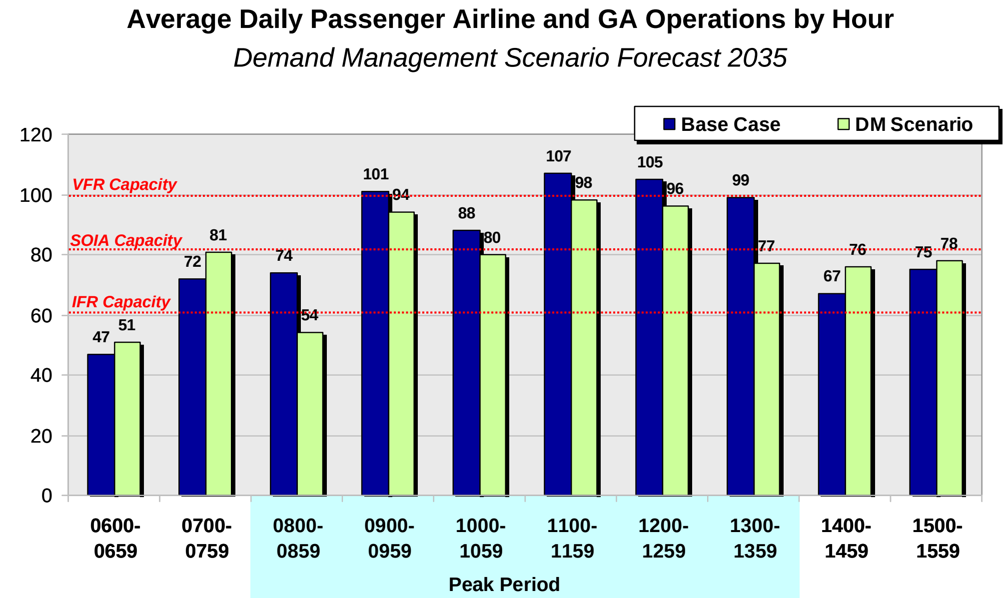
Exhibit 3-33 – Comparison of Forecast Passengers and Aircraft Operations at the Primary Airports, *Baseline vs. Demand Management Scenario*

	Passengers				Operations			
Year and Scenario	OAK	SFO	SJC	Total	OAK	SFO	SJC	Total
Base Year 2007	14,616,594	35,317,241	10,658,389	60,592,224	337,295	373,015	199,742	910,052
Foreast 2020:								
Baseline	16,332,161	46,124,417	12,850,537	75,307,115	301,091	431,172	202,556	934,819
Demand Management	16,332,161	46,124,417	12,850,537	75,307,115	301,091	431,172	202,556	934,819
Percent Change	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Foreast 2035:								
Baseline	20,655,297	64,356,302	16,305,371	101,316,970	354,945	526,595	242,739	1,124,279
Demand Management	20,655,297	64,179,608	16,305,371	101,140,276	354,945	505,303	242,739	1,102,987
Percent Change	0.0%	-0.3%	0.0%	-0.2%	0.0%	-4.0%	0.0%	-1.9%

Aircraft Operations

Demand Management eliminates 24,600 small passenger aircraft operations (less than 100 seats) from the peak period and increases peak period jet operations (100 or more seats) by 3.2 percent, or approximately 5,400 flights. The limitations on GA activity reduce GA operations during the peak period by 49 percent, or approximately 8,300 flights. SFO's total peak period aircraft operations (passenger airlines plus GA) in 2035 are reduced by approximately 9 operations per hour. (See Exhibit 3-34)

Exhibit 3-34 - With Demand Management, Peak Period Demand is Reduced by an Average of 9 Operations per Hour

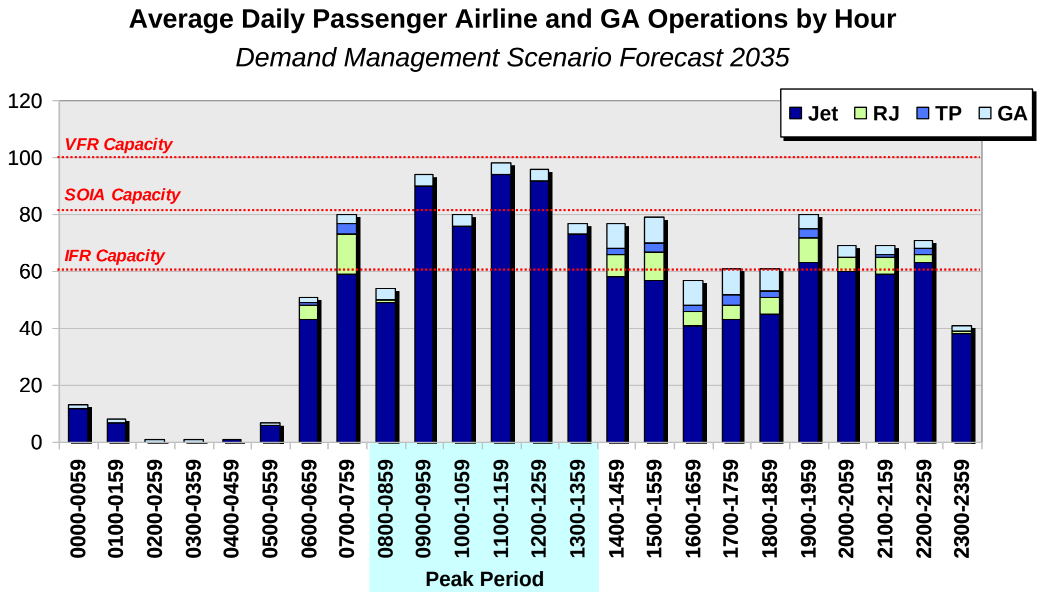


Note: Excludes all-cargo aircraft operations

In the Demand Management Scenario, total aircraft operations at SFO are reduced by approximately 4 percent or 21,300 flights. The estimated reduction in small aircraft activity is 32.6 percent, or 34,300 operations. As shown in Exhibit 3-35, demand management strategies are estimated to lower SFO's hourly aircraft demand to below VFR capacity during the peak period. However, hourly aircraft demand is forecast to remain higher than the airport's IFR capacity for most of the operating day.

The effectiveness of demand management strategies to eliminate serious delays in poor weather conditions is limited for two reasons. First, the share of total operations in small aircraft declines over the forecast period from 35 percent in 2007 to 20 percent in the 2035 Baseline as operations in larger aircraft, primarily those serving international destinations, are forecast to increase the fastest. Second, the Baseline forecast assumes that airlines will naturally up-gauge the 30 and 50-set aircraft in service today to larger 70-seat aircraft over the forecast period as the smaller aircraft age and become uneconomical in a high fuel price environment.

Exhibit 3-35 – With Demand Management, Passenger Airline and GA Demand is Lower than VFR Capacity During the Peak, But Remains Well Above IFR Capacity



3.7 New Air Traffic Control Technologies

3.7.1 Background and Assumptions

This scenario was developed to assess improved Air Traffic Control (ATC) Technologies as potential tools for allowing the region to better accommodate future aviation demand. The first step was to review on-going research and development activity by the FAA, EuroControl, NASA and the industry to identify potential concepts for improving airport capacity. Many of the technologies under study will not directly impact airport capacity in the Bay Area, either because they apply to airspace improvements (e.g., enroute or terminal area) or they are enabling technologies which will allow other concepts to be implemented (e.g., communications technology).

Recommended ATC Technologies

RAPC established an ATC Working Group with recognized experts in ATC and airport operations to identify potential technologies that could effectively increase capacity at the three Bay Area commercial airports, and to estimate the approximate implementation timeframe of each recommended technology. The ATC improvements selected by the Working Group for further analysis in the Bay Area are listed and described in Exhibit 3-36.

Exhibit 3-36 – ATC Technologies with Potential Capacity Benefits at Bay Area Airports

Technology	Purpose
Required Navigation Performance (RNP)	Navigation along a route, in a procedure, or in airspace within which the aircraft must comply with designated performance requirements. Relies on two concepts for operations under IFR--RNAV & RNP--to permit more flexible and efficient routings with reduced separations.
Simultaneous Offset Instrument Approaches (SOIA)	Instrument approach procedure to improve access to closely spaced parallel runways under reduced viibility conditions. Uses an ILS on one runway and an angled LDA on the other to achieve visual separation on short final. Requires PRM.
Dependent ILS Approaches to Closely Spaced Parallel Runways	Recent FAA authorization for allowing staggered pairs of aircraft with vertical separation to conduct simultaneous dependent ILS approaches to closely spaced parallel runways (CSPR) down to Category 1 minimums.
Cockpit Display of Traffic Information (CDTI) Assisted Visual Separation (CAVS)	Pilot display to maintain airport capacity by delaying the transition from visual approach operations to instrument approach operations as weather conditions deteriorate. CDTI supplements out-the-window visual contact and allows the pilot to lose sight of the aircraft ahead while stil maintaining equivalent visual separation. By expanding the weather conditions under whihc visual separation may be applied, airport capacity is enhanced.
Center Terminal Radar Approach Control (TRACON) Automation System (CTAS)	Advanced operating system for air traffic controllers to improve arrival aircraft sequencing, runway assignment and separation. Improves capacity by reducing separations and providing more efficient terminal area routings.
Airport Surveilance Detection Equipment (ASDE-X)	Uses multiple data sources to provide air traffic controllers with a reliable depiction of aircraft on the taxiways or in the air nearby, along with their identification, during reduced visibility. Displays a map of the airport and indicates surface vehicles. Improves capacity by giving controllers the equivalent perception of airfield activity as under visual conditions.
Wake Vortex Advisory System (WakeVAS)	Enables controllers to predict aircraft wake vortex and reduce separation standards between some aircraft landing on closely spaced parallel runways under certain wind conditions.

The Working Group identified five technologies which would be applicable at all three commercial Bay Area airports and the timeframes of when each would be available. These technologies and how they would improve capacity are:

By 2020:

- **Center-TRACON Automation System (CTAS)**
  - Reduces approach separation variations.
- **Airport Surface Detection Equipment (ASDE-X)**
  - Enhances taxiway flows and reduce runway conflicts under non-visual conditions.
- **Required Navigational Performance (RNP)**
  - Permitted more flexible and efficient arrival/departure routes. Increases departure airspace capacity.

By 2035:

- **Cockpit Display of Traffic Information Assisted Visual Separation (CAVS)**
  - Reduces aircraft separations in non-visual conditions.
  - Significantly reduces the problems caused by IFR weather today.
- **Wake Vortex Advisory System (WVAS)**
  - Reduces wake vortex separations under certain wind conditions.

Due to the unique issues at OAK and SFO, three additional ATC improvements were identified for these airports:

By 2020 at OAK:

- **Remove Instrument Landing System hold point on Runway 11**
  - Moves ILS antenna or uses RNP to reduce the existing large separations between landings and takeoffs under non-visual conditions during Southeast Plan operations.
  - Should dramatically reduce the excessive delays that occur today under IFR conditions when landing from west to east.

By 2020 at SFO:

- **Enhanced Simultaneous Offset Instrument Approaches (SOIA)**
  - Reduces minimum ceiling to 1,600 ft from 2,100 ft today.
  - Would enable SOIA operations to be conducted more frequently increasing arrivals during marginal weather conditions.

By 2035 at SFO:

- **Development of Paired Approach Instrument Procedures**
  - Uses Automated Dependent Surveillance – Broadcast (ADS-B) coupled to aircraft flight management systems and Cockpit Display of Traffic Information (CDTI) to allow paired approaches to continue under instrument weather conditions.

ATC Modeling Assumptions

The effects of the recommended ATC improvements on airport delays were evaluated using the same modeling framework as the Baseline Scenario for each future year. The ATC Working Group developed the assumptions for how each improvement would change the computer model inputs. This section describes the specific assumptions for modeling each ATC technology.

Center-TRACON Automation System (CTAS)

CTAS reduces the average separation time between arriving aircraft by giving the controller a computer tool to more accurately place aircraft on final approach. Exhibit 3-37 presents the standard deviation in seconds for aircraft beginning the approach at the Bay Area airports. The values for 2020 and 2035 were recommended by the ATC Working Group based on previous studies of this process. The IFR values are smaller than VFR because IFR conditions promote pilot and controller concentration which reduces variability.

Exhibit 3-37 – Standard Deviation Assumptions for Modeling Center-TRACON Automation System (in seconds)

Arrival σ (sec)	2007	2020	2035
IFR	15	12	6
VFR	20	17	11

Cockpit Display of Traffic Information Assisted Visual Separation (CAVS)

CAVS reduces aircraft separations in non-visual conditions and largely eliminates the problems caused by IFR weather today. Exhibit 3-38 presents the required spacing in nautical miles between consecutive arrivals in IFR conditions. The values for 2035 were obtained by adding 0.2 nm to the existing VFR arrival-arrival (AA) separations. In addition to the reduced AA separations, CAVS also enables paired approaches at SFO under MVFR and IFR weather conditions.

Exhibit 3-38 – Aircraft Spacing Assumptions for Consecutive Arriving Aircraft in IFR Conditions for Modeling CAVS *(in nautical miles)*

2007

Leading Aircraft	Trailing Aircraft S	L	5	H
S	3	3	3	3
L	4	3	3	3
5	5	4	4	4
H	6	5	5	4

2020

Leading Aircraft	Trailing Aircraft S	L	5	H
S	3	3	3	3
L	4	3	3	3
5	5	4	4	4
H	6	5	5	4

2035

Leading Aircraft	Trailing Aircraft S	L	5	H
S	2.7	2.7	2.7	2.7
L	2.9	2.7	2.7	2.7
5	3.9	3.1	3.1	3.1
H	4.7	3.8	3.8	3.1

Weight Classes

S	Small	<= 41,000 lbs
L	Large	>41,000, <= 255,000 lbs
5	B 757	
H	Heavy	> 255,000 lbs

Wake Vortex Advisory System (WVAS)

By using special sensors and improved knowledge of atmospheric and wake vortex behavior, WVAS will be able to reduce wake vortex separations under certain wind conditions. Presumably, WVAS will be able to eliminate the existing wake vortex separations under some conditions, but not all. Since it is not yet known when these reductions might be available, the ATC Working Group recommended applying a partial reduction under all wind conditions to capture the average effect of WVAS. The recommended adjustments are:

- Reduce IFR separations for consecutive arrivals (AA) above 3 nm by 1 nm.
- Reduce VFR separations for consecutive arrivals (AA) above 2.5 nm by the same ratio as current VFR to IFR.
- Reduce IFR separations for consecutive departures (DD) above 3 nm by 0.5 nm.
- Reduce VFR separations for consecutive departures (DD) above 3 nm by 0.5 nm.

Exhibits 3-39 and 3-40 present the assumed separation distances for consecutive arriving aircraft and consecutive departing aircraft for 2035 with WVAS.

Exhibit 3-39 – Aircraft Spacing Assumptions for Consecutive Arriving Aircraft in IFR and VFR Conditions for Modeling WVAS *(in nautical miles)*

AA IFR Separations

(nm)

2007

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	3	3	3	3
L	4	3	3	3
5	5	4	4	4
H	6	5	5	4

2020

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	3	3	3	3
L	4	3	3	3
5	5	4	4	4
H	6	5	5	4

2035

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	3	3	3	3
L	3	3	3	3
5	4	3	3	3
H	5	4	4	3

AA VFR Separations

(nm)

2007

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	2.5	2.5	2.5	2.5
L	2.7	2.5	2.5	2.5
5	3.7	2.9	2.9	2.9
H	4.5	3.6	3.6	2.9

2020

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	2.5	2.5	2.5	2.5
L	2.7	2.5	2.5	2.5
5.0	3.7	2.9	2.9	2.9
H	4.5	3.6	3.6	2.9

2035

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	2.5	2.5	2.5	2.5
L	2.5	2.5	2.5	2.5
5.0	3.0	2.5	2.5	2.5
H	3.8	2.9	2.9	2.5

See Exhibit 3-39 for aircraft weight classes.

Exhibit 3-40 – Aircraft Spacing Assumptions for Consecutive Departing Aircraft in IFR and VFR Conditions for Modeling WVAS *(in nautical miles)*

DD IFR Separations

(nm)

2007

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	3	3	3	3
L	3	3	3	3
5	5	4	4	4
H	5.0	5.0	5.0	4.0

2020

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	3	3	3	3
L	3	3	3	3
5	5	4	4	4
H	5.0	5.0	5.0	4.0

2035

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	3	3	3	3
L	3	3	3	3
5	4.5	3.5	3.5	3.5
H	4.5	4.5	4.5	3.5

DD VFR Separations

(nm)

2007

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	2.5	2.5	2.5	2.5
L	2.7	2.5	2.5	2.5
5	5	4	4	4
H	5	5	5	4

2020

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	2.5	2.5	2.5	2.5
L	2.7	2.5	2.5	2.5
5	5	4	4	4
H	5	5	5	4

2035

Leading Aircraft	Trailing Aircraft			
	S	L	5	H
S	2.5	2.5	2.5	2.5
L	2.7	2.5	2.5	2.5
5	4.5	3.5	3.5	3.5
H	4.5	4.5	4.5	3.5

See Exhibit 3-39 for aircraft weight classes.

SFO Simultaneous Offset Instrument Approaches (SOIA)

The FAA has been evaluating the feasibility of reducing the minimum ceiling for SOIA operations at SFO to 1,600 ft from 2,100 ft today by providing the air traffic controllers with enhanced computer tools. This will enable SOIA operations to be conducted more often (for an additional 2.7 percent of hours). The delay modeling assumes that the minimum ceiling for SOIA operations is 1,600 ft in 2020 and 2035.

Remove OAK ILS Hold Point on Runway 11

Currently when ILS landings take place on OAK's Runway 11, the location of the ILS glide slope antenna on the north side of the runway requires departures to hold well short of the runway threshold to avoid signal interference. If the glide slope antenna is moved to the south side, which involves significant environmental issues, or the ILS approach is eventually replaced with a GPS approach, the excessive separations between landings and takeoffs under instrument conditions would be eliminated. Exhibit 3-41 shows the assumed changes in the arrival-departure separation distances for 2020 and 2035 which were based on the 2007 NorCal IFR arrival rate for Runway 29.

Exhibit 3-41 - Aircraft Spacing Assumptions for Arriving-Departing Aircraft for Modeling the Removal of the ILS Hold Point on Runway 11 at OAK
(in nautical miles)

Remove ILS Hold	2007	2020	2035
Min AA sep (nm)	4.5	3.0	3.0
Min AD sep (nm)	2.5	2.0	2.0

3.7.2 Forecast Average Delays

Unlike the other scenarios which reduce aircraft delays by lowering passenger and aircraft demand at the primary Bay Area airports, in the ATC Scenario all of the forecast demand is accommodated at the primary airports but with less delay through capacity enhancements. Therefore the forecast passengers and aircraft operations for the ATC Scenario are the same as the Baseline. For the ATC Scenario the average delay per operation was calculated for each airport for each forecast year (2020 and 2035).[6] This section discusses the impact of the recommended ATC technologies on average aircraft delays at each of the primary airports.

The ATC improvements reduce average aircraft delays for all airports in both years, but particularly for SFO in 2035 where the average delay is reduced by more than half. (See Exhibit 3-42) At SFO, which is projected to have a serious delay problem in 2035, the average delay falls from 21.03 minutes in the Baseline to 10.35 minutes in the ATC Scenario.

Exhibit 3-42 – By 2035, ATC Improvements are Projected to Reduce Aircraft Delays by 22-51%

Average Delay Minutes

Baseline vs. ATC Improvements Scenario

	OAK			SFO			SJC		
Year	Baseline	ATC Improve-ments	Percent Change	Baseline	ATC Improve-ments	Percent Change	Baseline	ATC Improve-ments	Percent Change
2007	2.05			5.73			0.29		
2020	1.40	1.31	-6.4%	8.35	7.14	-14.5%	0.26	0.25	-3.8%
2035	3.47	3.02	-13.0%	21.03	10.35	-50.8%	0.37	0.29	-21.6%

Exhibit 3-43 summarizes the average delays by VFR and IFR conditions. ATC improvements produce the greatest delay reduction in IFR Conditions at SFO – a 71 percent decline in 2035.

[6] The delay reduction benefits for all of the other scenarios are presented in Chapter 4.

Exhibit 3-43 – ATC Improvements Produce the Greatest Delay Reduction in IFR Conditions at SFO – a 71% Decline in 2035

Average Delay Minutes
Baseline vs. ATC Improvements Scenario

	OAK			SFO			SJC		
Year	Baseline	ATC Improve-ments	Percent Change	Baseline	ATC Improve-ments	Percent Change	Baseline	ATC Improve-ments	Percent Change
VFR									
2007	0.39	0.39		2.33	2.33		0.57	0.57	
2020	0.45	0.39	-11.9%	2.15	2.01	-6.3%	0.16	0.15	-2.7%
2035	0.90	0.80	-11.2%	5.97	4.42	-25.9%	0.18	0.18	0.1%
IFR									
2007	7.58	7.58		16.73	16.73		3.94	3.94	
2020	4.24	3.95	-6.8%	23.88	19.07	-20.2%	3.22	3.07	-4.7%
2035	11.04	9.96	-9.8%	66.07	19.28	-70.8%	6.04	4.03	-33.2%

The ATC Scenario assumes a 100 percent equipage rate, i.e., it assumes that all the technologies included in the analysis are developed and adopted by all airlines operating at the Bay Area airports. Because of the uncertainty surrounding the timing and the extent to which the assumed technologies are deployed, a sensitivity analysis was performed. The sensitivity analysis assumes alternative equipage rates of 70 percent and 50 percent and it assumes that delay reduction is directly proportional to the equipage rate. As shown in Exhibit 3-44, under an equipage rate assumption of 70 percent, the average delay reduction benefit of ATC improvements at SFO would be 35.5 percent. Similarly, at a lower equipage rate of 50 percent, the delay reduction at SFO falls to 25.4 percent in 2035.

Exhibit 3-44 - Percent Reduction in Average Delays by Equipage Rate, *Baseline vs. ATC Improvements Scenario*

	OAK			SFO			SJC		
Year	100%	70%	50%	100%	70%	50%	100%	70%	50%
2020	-6.4%	-4.5%	-3.2%	-14.5%	-10.1%	-7.2%	-3.8%	-2.7%	-1.9%
2035	-13.0%	-9.1%	-6.5%	-50.8%	-35.5%	-25.4%	-21.6%	-15.1%	-10.8%

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Impacts of Scenarios on Study Goals

4.1 Introduction and Background

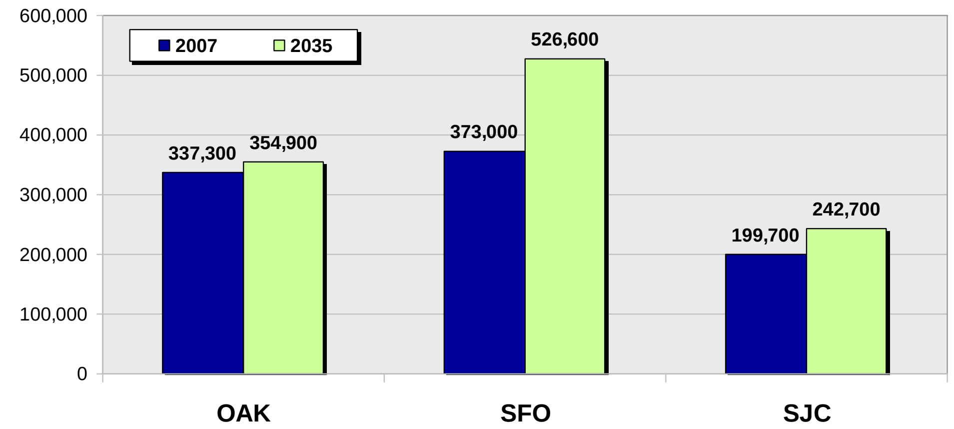
This section describes and summarizes the impacts of each scenario on the study goals: (1) reliable runways; (2) healthy economy; (3) good passenger service; (4) convenient airports; (5) climate protection; (6) clean air; and (7) livable communities. To assess the performance of each scenario, performance metrics, as shown in Exhibit 4-1, were defined for each goal. These measures allow for a comparison of each scenario's performance relative to the Baseline and relative to each other.

Exhibit 4-1 – Mid-Point Screening Goals and Performance Measures

Goal	Performance Measure
Reliable Runways	1. Average Aircraft Delays 2. Average 3-Hour Peak Delays
Healthy Economy	Primary Airports Have Adequate Capacity to Accommodate Forecast Demand
Good Passenger Service	Flights per Capita to Top Domestic Destinations
Convenient Airports	1. Average Access Time 2. Average Access Distance
Climate Protection	Green House Gas Emissions from Aircraft and Ground Access Vehicles
Clean Air	Criteria Pollutant Emissions (HC+NOx) from Aircraft and Ground Access Vehicles
Livable Communities	1. 65 CNEL Population 2. 55 CNEL Population

Several factors drive the performance of the scenarios. The dominant factor is the number of annual aircraft operations, which is directly related to airport capacity, air emissions and noise exposure. In the Baseline forecast, total aircraft operations at the primary Bay Area airports are forecast to increase by 24 percent between 2007 and 2035. Aircraft operations are forecast to grow the fastest at SFO increasing by 41 percent from 373,000 in the base year to 526,600 in 2035. (See Exhibit 4-2) The forecasts of operations and aircraft fleet for each airport reflect changes in aircraft types, aircraft fuel efficiency and aircraft noise characteristics.

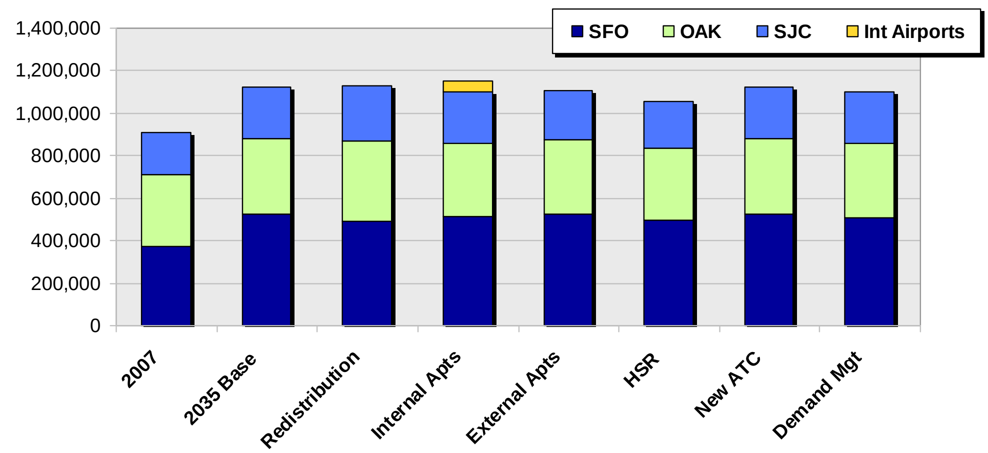
Exhibit 4-2 – Base Year and Forecast Aircraft Operations, by Airport



Other factors that influence scenario performance include the aircraft fleet mix, airline schedules, and aircraft delays. The forecast aircraft fleets, which also serve as inputs to the air quality and noise modeling, reflect changes in aircraft types, aircraft fuel efficiency and aircraft noise characteristics. The hourly timing of airline flights can contribute to aircraft delays during peak periods of activity and late night flights have a higher weighting than day and evening flights in the noise modeling. Finally, while aircraft delays is a performance measure it can also contribute to increased GHGs and air emissions as aircraft taxi times increase with flight delays. Similarly, aircraft delays can contribute to greater levels of noise exposure as aircraft flights are delayed into the noise sensitive evening and nighttime hours.

Total aircraft operations at the three Bay Area airports are forecast to increase from 910,000 in the base year to 1,124,000 in the 2035 Baseline. (see Exhibit 4-3) The forecast 2035 level of aircraft operations for each scenario varies from the 2035 Baseline, but overall there are relatively small differences between the scenarios. The High-Speed Rail Scenario has the greatest effect on reducing forecast aircraft demand. In the High-Speed Rail Scenario, total aircraft operations for the primary Bay Area airports falls by 6 percent. This is a result of the passenger diversion forecast, in which 6.1 million air passengers are projected to shift from air to rail. All but one of the scenarios shows a decrease in aircraft operations. The Internal Secondary Airports Scenario actually increases total aircraft operations in the region by 2.6 percent when factoring in the assumed new air services at the regional airports. There is a net increase in regional aircraft activity under this scenario because passengers are shifted from the primary airports where they are generally served with narrowbody jets to the alternative airports (Sonoma County, Buchanan, and Travis) where all services are assumed to be operated with smaller, 70-seat aircraft.

Exhibit 4-3 – Forecast Aircraft Operations by Scenario, 2035



Note: Operations shown for the internal regional airports (Sonoma County, Buchanan Field and Travis Air Force Base) reflect only the incremental activity that results from diversion from the primary Bay Area airports.

At SFO, which is forecast to reach its airside capacity around 2025, the Redistribution Scenario has the greatest effect on reducing aircraft operations. Under the Redistribution Scenario, aircraft operations at SFO are 7 percent lower than the 2035 Baseline forecast. High-Speed Rail and Demand Management are the next best scenarios, lowering SFO's aircraft operations by 5.3 percent and 4.0 percent, respectively. Internal Secondary Airports reduces aircraft demand at SFO by 2.0 percent and External Secondary Airports lowers aircraft operations by less than one percent.

4.2 RELIABLE RUNWAYS

A key study goal is to reduce aircraft flight delays and passenger inconvenience in the Bay Area. Two measures were defined to asses each scenario's performance against this goal. The first is average aircraft delay in minutes and the second is the average aircraft delay for the busiest three-hour period. The scenario results focus solely on average delays at SFO, which in the Baseline is the only airport that is forecast to reach capacity over the forecast period. The results for each of these measures are discussed in the following sections.

4.2.1 Average Aircraft Delays

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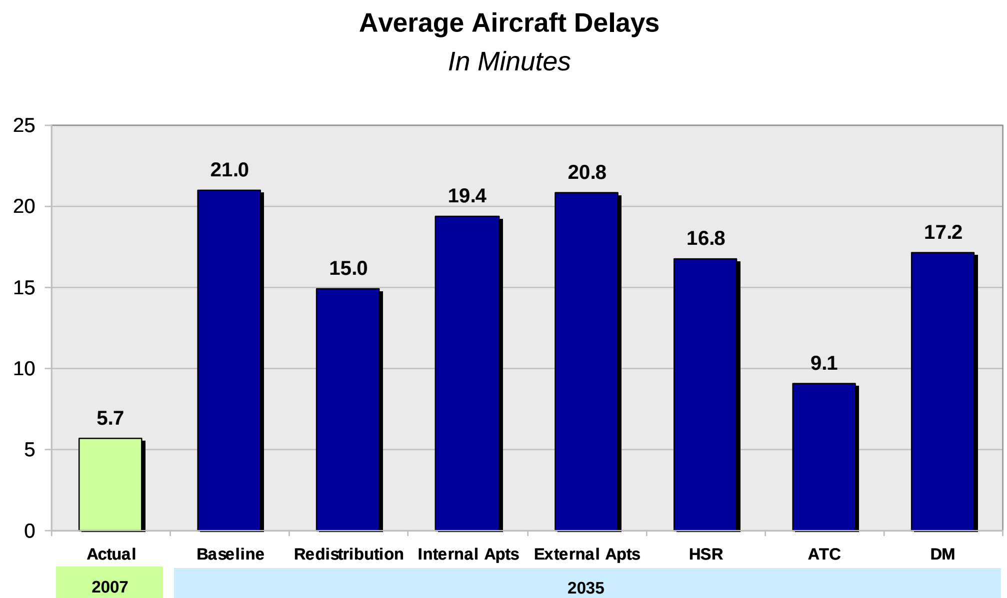
The scenario forecasts of aircraft operations and fleet mix served as inputs to the capacity and delay models, as described in the *Baseline Runway Capacity and Delays* report, to determine the average aircraft delay for each airport under each alternative scenario. A threshold level of 12 to 15 minutes of average aircraft delays was used in the Baseline capacity analysis to estimate the maximum level of operations that an airport's runway system could handle without excessive delays. The same delay threshold was used to assess the performance of each scenario in meeting the reliable runways goal.

Under the Baseline forecast, average aircraft delays at SFO increase from 5.7 minutes in 2007 to 21.0 minutes in 2035. (Exhibit 4-4) The ATC Scenario, which is the only scenario that increases runway capacity, produces the greatest delay reduction and reduces average delay to below the threshold level. With full implementation of the assumed ATC improvements at the Bay Area airports, the forecast of average aircraft delays at SFO falls by more than 50 percent from 21.0 minutes in the Baseline to 9.1 minutes. The Redistribution Scenario significantly lowers the average aircraft delay at SFO to 15.0 minutes, but not enough to reduce average delay below the threshold level. High-Speed Rail and Demand Management have a similar effect reducing the average aircraft delay to approximately 17 minutes. The Internal and External Secondary Airports Scenarios produce the least delay reduction benefit, with average delays of 19.4 and 20.8 minutes, respectively.

Exhibit 4-4 – Average Aircraft Delays at SFO, by Scenario

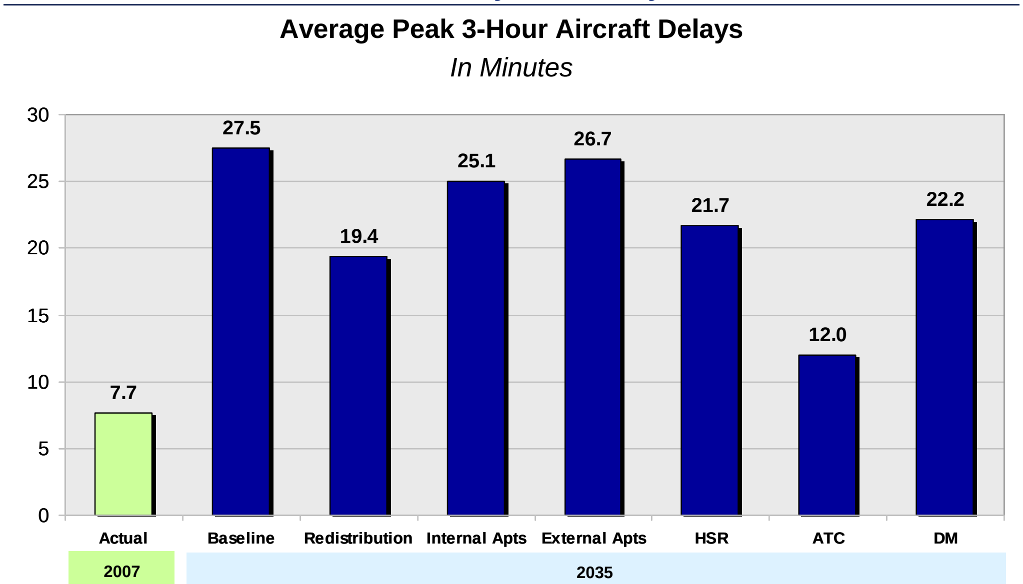


4.2.2 Average 3-Hour Peak Period Delays

A second delay measure that quantifies the average delay during the most delayed three hour period was also used to assess the performance of each scenario in meeting the reliable runways goal. This measure is intended to capture the worst delay conditions that passengers would typically encounter in terms of schedule disruptions. The threshold level for this measure was set at 20 minutes, approximately 33 percent higher than the 15-minute threshold for average delay.

In the Baseline forecast, the average peak 3-hour delay at SFO increases from 7.7 minutes in 2007 to 27.5 minutes in 2035, well above the threshold level. As shown in Exhibit 4-5, the most effective alternative is new ATC improvements. The average peak 3-hour delays falls from 27.5 minutes in the Baseline to 12.0 minutes with full implementation of the ATC improvements. The Redistribution Scenario also lowers the peak 3-hour delay significantly to 19.4 minutes, which is just below the threshold level. All of the other scenarios have an average peak 3-hour delay that exceeds the 20-minute threshold.

Exhibit 4-5 – Peak 3-Hour Aircraft Delays at SFO, by Scenario



4.3 HEALTHY ECONOMY

An efficient regional airport system supports the region's economic growth by accommodating business travel and serving visitors who spend money in the Bay Area, which also increases tax revenues for local governments. In the competitive global economy, maintaining good airline access to the region is essential. Aircraft delays impose real costs on air passengers, Bay Area businesses and the airlines. Excessive delays at SFO in the late 1990s have been linked to a downturn in the region's convention bookings and tourism during that period. Thus, average aircraft delay is used as a proxy measure to assess the performance of each scenario in promoting a healthy economy for the Bay Area region.

As shown in Exhibit 4-6, the performance of each scenario in meeting the healthy economy goal is rated based on its average aircraft delay at SFO. The ATC Scenario is rated High because average aircraft delay with the ATC improvements is 9.1 minutes, which falls below the delay threshold. The Redistribution, High-Speed Rail and Demand Management Scenarios have average delays of 15-17 minutes and are rated Medium. The scenarios with the highest average delays, Internal and External secondary Airports, are given a Low rating.

Exhibit 4-6 – Healthy Economy and Average Delays at SFO, by Scenario

Scenario	2035 SFO Avg Aircraft Delay (minutes)	Healthy Economy Rating
Baseline	**21**	**Low**
Redistribution	**15**	**Medium**
Internal Regional Airports	**19**	**Low**
External Regional Airports	**21**	**Low**
High-Speed Rail	**17**	**Medium**
New ATC Technologies	**9**	**High**
Demand Management	**17**	**Medium**

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4.4 GOOD PASSENGER SERVICE

Another goal for the region is to improve service to and from the region's major air travel markets. Each scenario was assessed in terms of its ability to provide service to the region's top air travel markets. The performance metric for this goal was defined as annual aircraft departures per capita in the Bay Area's top 15 domestic origin-destination (O&D) markets. Since the transportation needs of some passengers in the High-Speed Rail Scenario can be accommodated by an alternative mode, train frequencies are counted as flights in the performance metric. Exhibit 4-7 shows the region's top O&D markets in 2035. Four of the top 15 markets, i.e., Los Angeles, Burbank, Orange County and San Diego, would be linked to the Bay Area with high-speed train service in the High-Speed Rail Scenario. Ontario ranks as the 18th largest O&D market in 2035, but was included in the good service measure since it serves passengers traveling to the Los Angeles area.

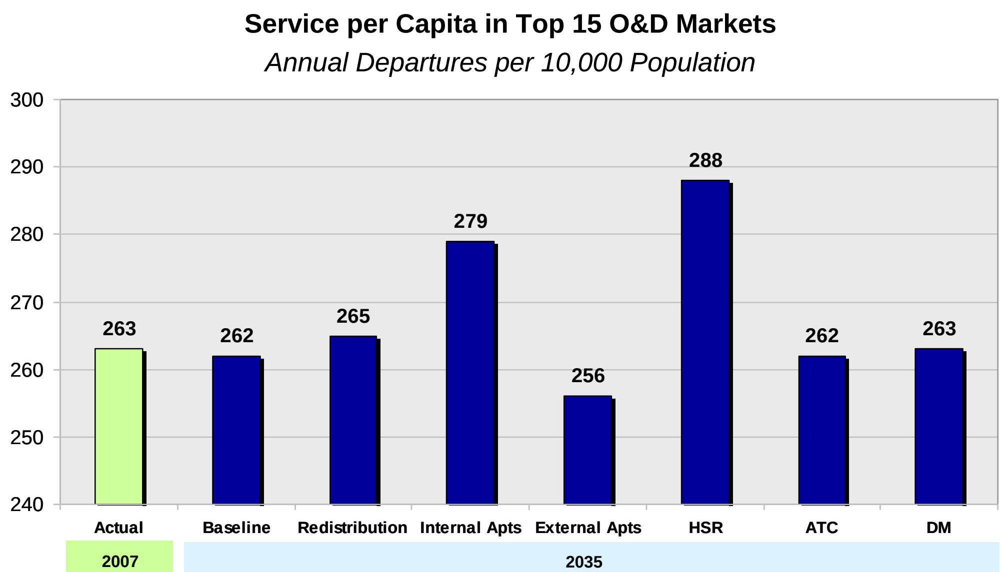
Exhibit 4-7 – Top 15 Domestic O&D Passengers Markets for the Bay Area Region, *Base Case 2035*

Rank	Market	2035 O&D Passengers	Percent of Total
1	New York	4,349,120	6.9%
2	Los Angeles	4,178,694	6.6%
3	Las Vegas	3,986,539	6.3%
4	Seattle	3,724,052	5.9%
5	San Diego	3,557,524	5.6%
6	Orange County	2,469,276	3.9%
7	Portland	2,460,057	3.9%
8	Chicago	2,436,467	3.8%
9	Denver	2,238,593	3.5%
10	Phoenix	1,998,001	3.1%
11	Burbank	1,823,320	2.9%
12	Washington, DC	1,782,370	2.8%
13	Boston	1,745,787	2.7%
14	Dallas/Ft. Worth	1,434,236	2.3%
15	Salt Lake City	1,367,780	2.2%
	Subtotal	39,551,817	62.3%
	All Other	23,932,453	37.7%
	Total	63,484,270	100.0%

In the Baseline forecast, air service in the top O&D markets is virtually flat between 2007 and 2035 at 263 and 262 annual departures per 10,000 persons, respectively. (See Exhibit 4-8) The service measure is virtually unchanged because growth in departures in the top 15 O&D markets is projected to keep pace with the projected growth in population. The High-Speed Rail Scenario produces the highest level of service with 288 because of the high frequency of train services. Even though aircraft departures are reduced in the High-Speed Rail Scenario as passengers shift from air to train mode, there is a net increase in service because of the high–frequency of the proposed high-speed rail services.

Internal Secondary Airports is the second best scenario with a projected 279 departures per 10,000 persons. External Secondary Airports, which results in fewer aircraft operations within the region as air services develop at out-of-region airports, produces the lowest level of service at 256 departures per 10,000 persons, which is also lower than the Baseline service level. The other scenarios, i.e., Redistribution, ATC and Demand Management, produce about the same level of service as in the Baseline forecast at 262 to 265 departures.

Exhibit 4-8 – Flight Frequency per Capita in Top 15 Domestic O&D Markets, by Scenario



Note: 2035 population is based on ABAG's 2007 Projections for the nine-county Bay Area region.

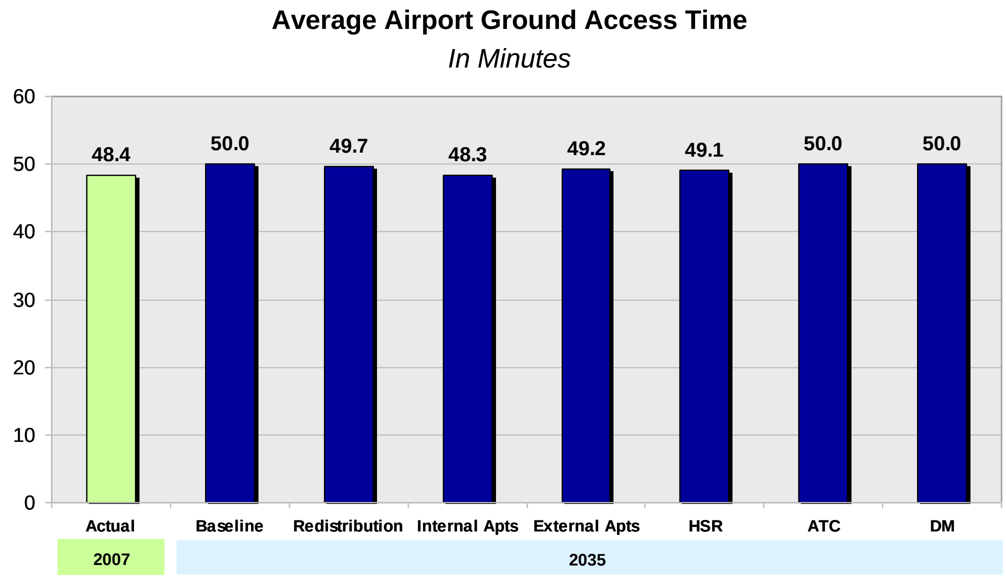
4.5 CONVENIENT AIRPORTS

The objective of the Convenient Airports goal is to maintain or improve airport access times. Two measures were established to assess each alternative's performance relative to the convenient airports goal. The first is average ground time for air passengers accessing the airports and the second is the average ground access distance for air passengers. The analysis is based on the allocation of forecast demand to trip origin zone for each of the scenarios at the level of MTC travel analysis zones (TAZs) and the system of external zones defined for the study as part of the forecast demand allocation task. The assumed future ground access mode use by trips from each analysis zone is based on an analysis of the mode use reported in the most recent MTC air passenger surveys for the three primary commercial service airports, with appropriate adjustments for anticipated future changes in mode use. Highway travel times and vehicle miles traveled (VMT) for 2035 are based on highway network travel times and distances predicted by the MTC regional travel analysis modeling system. For the High-Speed Rail Scenario, the analysis includes travel to the high-speed rail stations. The scenario results for each measure are discussed below.

4.5.1 Ground Access Time

The average passenger ground access time for the 2035 Baseline case is 50.0 minutes, compared to 48.4 minutes in the 2007 base year, due largely to projected increases in congestion on the region's streets and highways. (Exhibit 4-9) The Internal Secondary Airports Scenario results in the lowest average passenger ground access time, i.e., 48.3 minutes, as a portion of the region's passengers use closer secondary airports in this scenario. While the improvement in the average access time for the Internal Secondary Airports Scenario is under 2 minutes, passengers using the secondary airports experience significantly greater reductions in average access time. All of the scenarios, except for ATC and Demand Management, result in average ground access times that are slightly lower than the 2035 Baseline. The average access time remains unchanged for the ATC and Demand Management Scenarios, since there is no change in air passenger demand by airport in these scenarios.

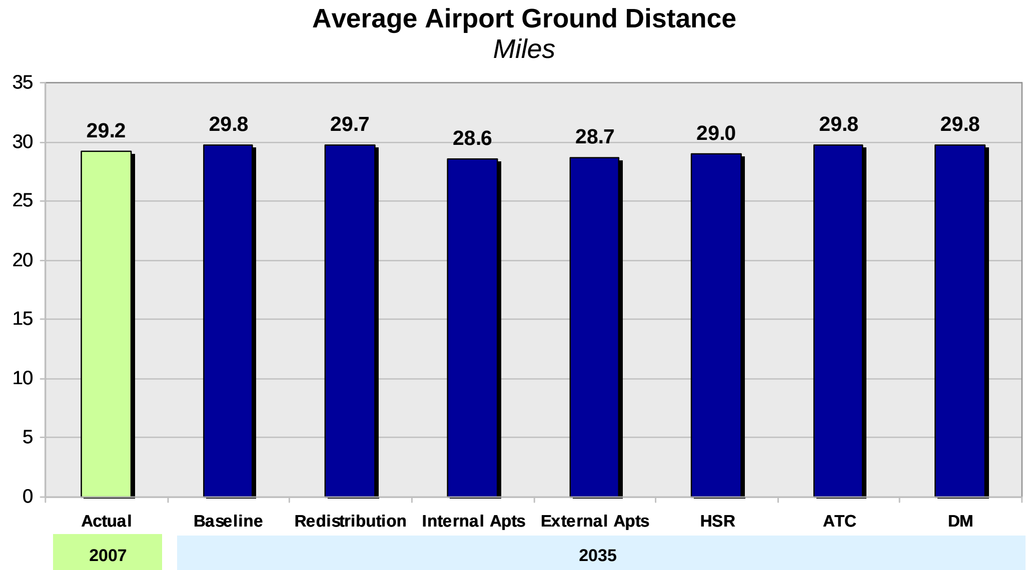
Exhibit 4-9 – Average Passenger Ground Access Times, by Scenario



4.5.2 Ground Access Distance

The average ground distance for passengers traveling to the primary airports in the 2035 Baseline is 29.8 miles, up slightly from the 2007 base year distance of 29.2 miles. (Exhibit 4-10) The Internal Secondary Airports Scenario results in the lowest average distance at 28.6 miles, because a portion of the forecast Bay Area passengers are assumed to use the closer secondary airports. As with average ground access times, all of the scenarios except ATC and Demand Management result in slightly lower average ground distances than the Baseline.

Exhibit 4-10 - Average Passenger Ground Access Distance, by Scenario



4.6 Climate Protection

The climate protection goal evaluates greenhouse gas (GHG) emissions from aircraft and vehicle trips to and from the airports. A number of local, state and national efforts are underway to control growth in GHGs. The performance metric for the climate protection goal is daily tons of carbon dioxide (CO_2) produced by aircraft and air passenger vehicle trips.

Aircraft emissions, including emissions from ground support equipment (GSE)[7] and auxiliary power units, were developed using the latest version of FAA's EDMS 5.1.1 modeling tool. Aircraft emissions were calculated for five aircraft operating modes: taxi-out, takeoff, climb-out, approach, and taxi-in. The sum across all modes gives the total emissions for a particular aircraft type and the sum of all emissions across all aircraft types (sizes, designation, engine type and uses) determines the total annual emissions for the airport.

Emissions from secondary airports in the Bay Area region are excluded except for the Internal Secondary Airports Scenario, which includes emissions from assumed new air services at Sonoma County Airport, Buchanan Field, and Travis Air Force Base. The External Secondary Airports Scenario does not include aircraft emissions at the

[7] GHG emissions from GSE are included in the base year 2007 analysis. In 2035 all GSE are assumed to be electrified resulting in no on-airport GHGs from GSE.

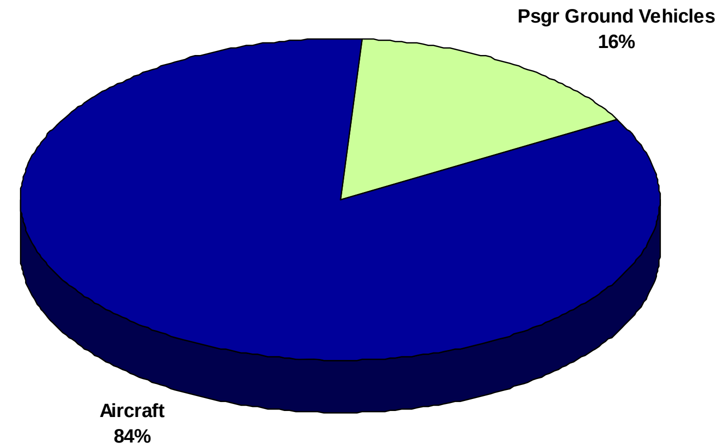
secondary airports, as these emissions are generated outside the Bay Area, which is the boundary for the analysis. Future year aircraft emissions reflect projected aircraft delays and improvements in the fuel efficiency of the aircraft fleet.

Ground vehicle emissions are based on projections of ground access and egress vehicle trips by mode between each regional travel analysis zone, including the external zones, and each Bay Area airport. For the High-Speed Rail Scenario, the analysis includes emissions from passenger vehicle trips to the rail stations. CO_2 emission rates per vehicle-mile were provided by MTC staff based on average vehicle emission rates for the Bay Area vehicle fleet calculated using the California Air Resources Board EMFAC model. These reflect the increasing fuel efficiency of the automobile fleet as mandated by the latest federal standards.

Emissions from high-speed rail trains are excluded from the High-Speed Rail Scenario since the majority of forecast HSR riders are estimated to be diverted from ground modes, predominantly automobile travel. Only 15 percent of forecast HSR riders are estimated to be diverted from air travel. However, a sensitivity analysis, which is summarized in the following section, was performed to assess the relative impact of train substitution for air travel.

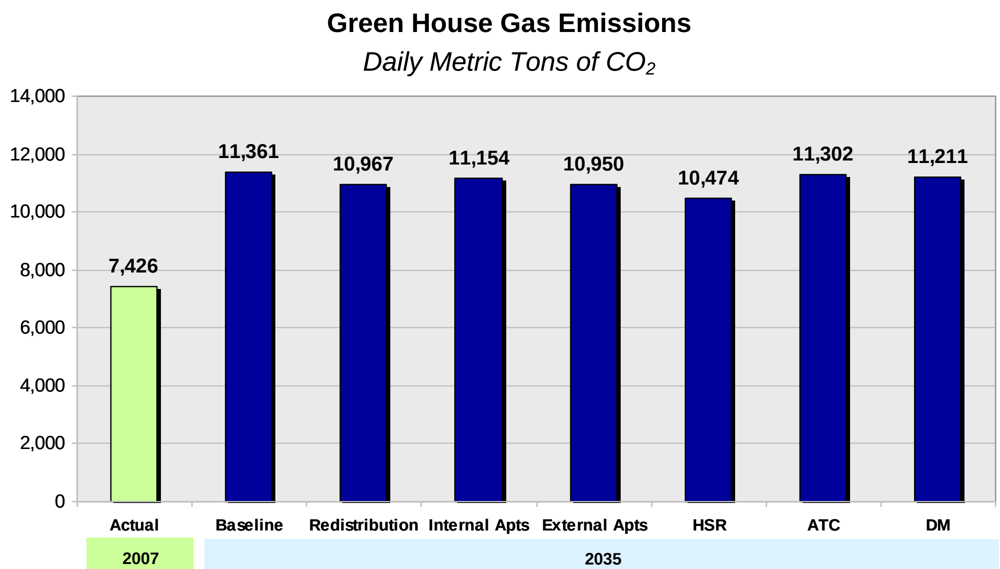
Total GHG emissions from aircraft sources and ground access vehicles increase significantly, by 53 percent, from 7,426 metric tons per day in the 2007 base year to 11,361 per day in the 2035 Baseline. Despite improvements in the fuel efficiency of aircraft, the increase in aircraft operations is the main driver of higher GHG emissions. Furthermore, most of the least fuel efficient aircraft were retired in 2008 when fuel prices rose to record levels and the older models become uneconomical to operate. The estimated gain in the fuel efficiency of the SFO aircraft fleet between 2007 and 2035 is estimated at 5 percent. As shown in Exhibit 4-11, GHG emissions from aircraft account for 84 percent of the combined aircraft and ground vehicle emissions in the 2035 Baseline.

Exhibit 4-11 - 2035 Baseline GHG Emissions, by Source



As shown in Exhibit 4-12, all of the scenarios result in slightly lower GHG emissions compared to the 2035 Baseline. The High-Speed Rail Scenario, which excludes emissions from the train operations, produces the lowest level of aircraft and ground access vehicle emissions at 10,474 daily metric tons. Even the ATC and Demand Management Scenarios result in slightly lower emissions than the Baseline as a result of lower levels of aircraft taxi delays.

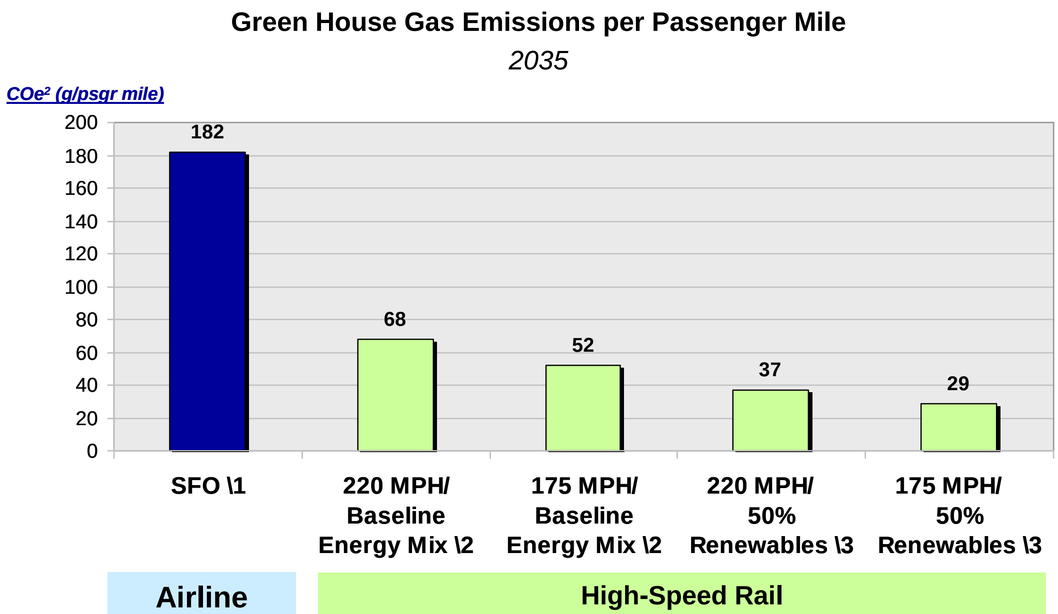
Exhibit 4-12 – Green House Gas Emissions, by Scenario



Notes: Includes emissions from aircraft and airport ground access vehicles.
Internal Airports Scenario includes emissions from new air services at alternative airports.
External Airports Scenario excludes emissions from service development at airports outside the region.
HSR Scenario excludes emissions for rail service, but includes emissions from passenger vehicle trips to rail stations.

While the results do not include emissions from the trains in the High-Speed Rail Scenario, a sensitivity analysis comparing GHG emissions of aircraft and HSR trains on a passenger mile basis was conducted. The average emissions for the least and most efficient aircraft in the SFO fleet are 182 grams of CO_2-equivalent gases per passenger mile. (See Exhibit 4-13) GHG emissions from high-speed trains were evaluated for various average speed and fuel mixes because of the uncertainty surrounding the actual performance and power sources for the proposed rail system. By comparison, the train at various speed and fuel mix assumptions emits much less CO_2-equivalent gases than the average of the least and most fuel efficient aircraft. The HSR train emits 29 to 68 grams per passenger mile. Based on this comparative analysis, the High-Speed Rail Scenario is expected to result in a net reduction in GHGs.

Exhibit 4-13 – Comparison of GHG Emissions for Air and HSR Modes



\1 Average of most fuel efficient aircraft (A-319) and the least fuel efficient (A-321).
\2 Current Baseline for CA based on CA Energy Commission 2008 Total System Power.
\3 Remaining 50% from natural gas (29.2%), coal (8.5%) and nuclear (12.3%).

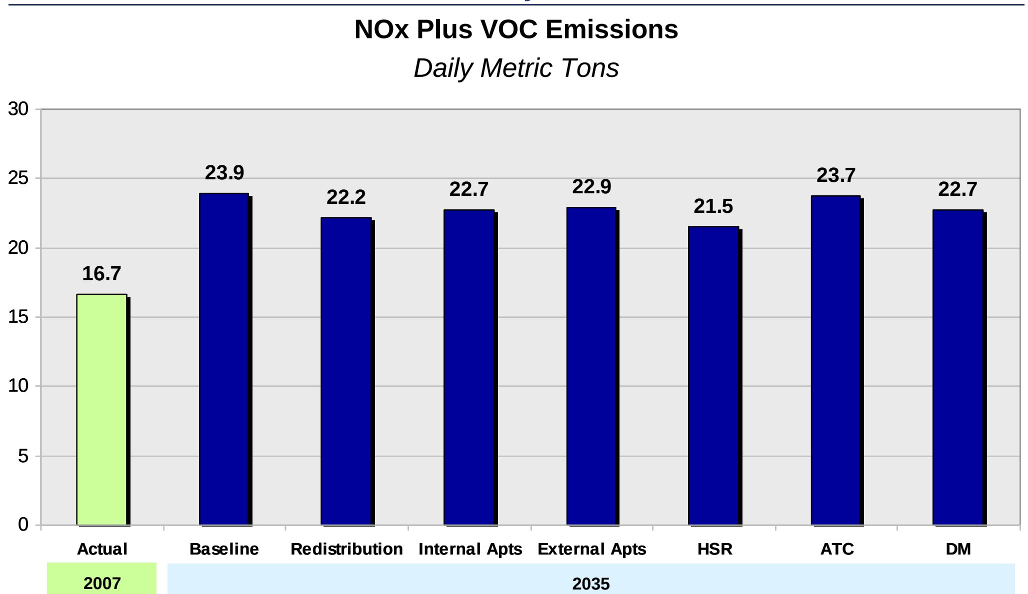
4.7 Air Quality

For the clean air goal the analysis assesses air pollution from aircraft operations and passenger vehicle trips to and from the airports. The performance measure for the Clean Air goal includes the daily tons of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) produced by aircraft and ground access vehicles. These two pollutants negatively affect air quality by combining in the presence of sunlight to create ground level ozone, a major component of smog.

The emissions for these criteria pollutants were modeled similarly to the GHG emissions as described in Section 4.6 with one exception. The GHG emissions were modeled out to a 40 nm horizontal radius, while the emissions for the criteria pollutants were modeled for the phases of flight up to an altitude of 2,300 feet.

For the 2035 Baseline, aircraft and ground access vehicles emit 23.9 tons of VOCs and NO_x per day, an increase of 43 percent over the 2007 base year emissions. (See Exhibit 4-14) Similar to the GHG emissions, the projected increase in aircraft operations is the main driver of increases in air emissions despite improvements in the fuel efficiency of aircraft and ground vehicles. As shown in Exhibit 4-15, aircraft operations account for 97 percent of total emissions in the 2035 Baseline. The High-Speed Rail Scenario results in the lowest level of VOC and NO_x emissions at 21.5 daily tons, a 10 percent reduction over the Baseline emissions level, due to the reduction in aircraft operations that results from passenger diversion to HSR. The emissions for all the other scenarios are slightly lower than Baseline and range from 22.2 tons per day for Redistribution to 23.7 tons per day for the ATC Scenario.

Exhibit 4-14 –NO_x and VOC Emissions, by Scenario



Notes: Includes emissions from aircraft and airport ground access vehicles.
Internal Airports Scenario includes emissions from new air services at alternative airports.
External Airports Scenario excludes emissions from service development at airports outside the region.
HSR Scenario excludes emissions for rail service, but includes emissions from passenger vehicle trips to rail stations.

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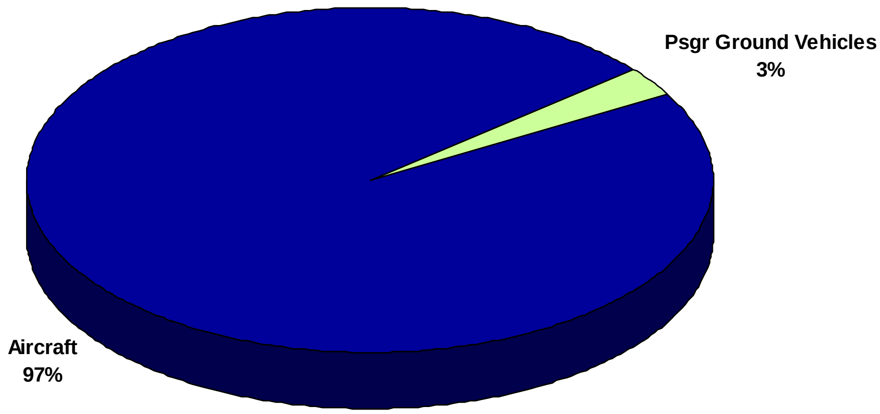
Exhibit 4-15 – 2035 Baseline NO_x and VOC Emissions, by Source



4.8 NOISE

The impact of the scenarios on noise exposure in the communities surrounding the airports was also examined using two metrics. One metric is the residential population living within the 65 decibel (dB) Community Noise Equivalent Level (CNEL) contour and the second metric is the population within the 55 CNEL contour.

The 2007 airport contours are based on actual data provided by the airports. The areas of the 2035 Baseline and scenario contours were estimated using the Federal Aviation Administration's (FAA) Area Equivalent Method (AEM). The AEM is a spreadsheet model which estimates the percentage change in the area of the 65 dB Day-Night Average Sound Level (DNL) contour using only total daytime and nighttime aircraft operations specified by INM aircraft types for the base year and future year cases. The AEM method does not consider flight tracks, stage lengths, runway geometry, or aircraft profiles and thus does not account for potential changes in these parameters.

The 2007 base year and 2035 forecast populations are based on estimates provided by the Association of Bay Area Governments (ABAG, *Projections 2007*). The residential population data is divided into Census tracts and the AEM-adjusted noise contours are superimposed to determine the total population affected by 65 CNEL and 55 CNEL noise under the various scenarios. These policy forecasts assume more growth in the Central core of the Bay Area and in Priority Development Areas next to transit services. Thus, compared to 2007, there will be some increases in residential population in areas around airports and within the 65 and 55 CNEL noise contours. As a result, the analysis for each Scenario shows what the impact would be if the 2007 population in each census tract remained the same in 2035 as well as the impact with the higher population base assuming ABAG's policy forecasts.

Changes in the size of the airport noise contours largely reflect the impact of increases or decreases in aircraft operations and changes in aircraft fleet mix. Even though changes in aircraft types are considered in the future year fleets, the increase in operations is greater than any benefits resulting from improvements in the noise characteristics of the airline fleet largely because the noisiest aircraft have already been retired from airline fleets. In addition, the contours wil be affected by the hourly profile of aircraft demand. Specifically the future year cases consider aircraft delays and the impact of delays on scheduled flights. For example, flights scheduled during the daytime period (7 a.m. to 7 p.m.) may be delayed into the more noise sensitive evening period (7 p.m. to 10 p.m.) and evening flights may be delayed into the most noise sensitive nighttime period (10 p.m. to 7 a.m.).[8]

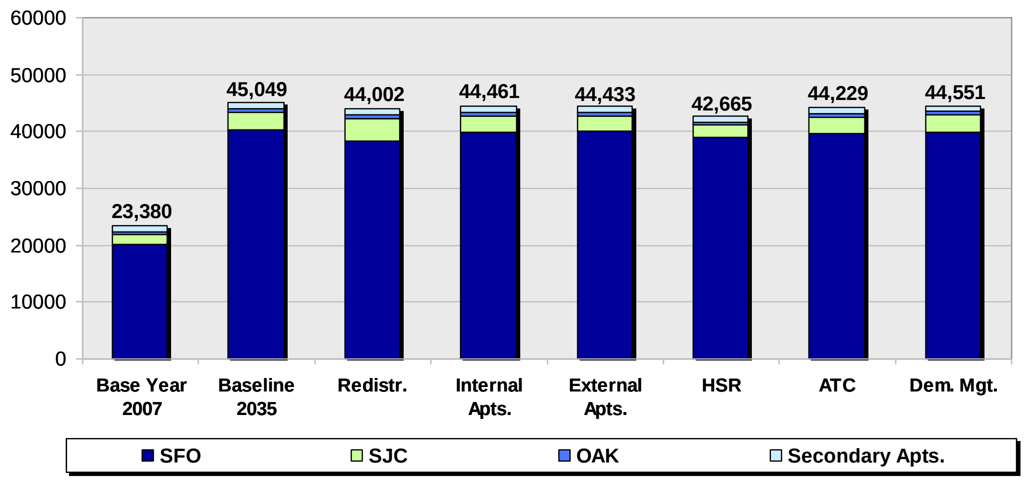
4.8.1 Population within 65 CNEL

Exhibit 4-16 summarizes the populations within the 65 CNEL contour for the 2007 base year, the 2035 Baseline and the 2035 scenario cases using 2007 population data. As shown, population exposed to 65 CNEL nearly doubles from 23,380 in the 2007 base year to 45,049 in the 2035 Baseline. The results do not attempt to assess how much of the population lives in homes that have been sound insulated through airport and FAA sponsored mitigation programs and would be considered "noise compatible" under California's airport noise standards.

The High-Speed Rail Scenario results in the lowest 65 CNEL population at 42,665. There are no material differences in the other scenarios which result in approximately 44,000 persons in the 65 CNEL.

[8] In determining CNEL, it is assumed that the aircraft noise emissions occurring at night (10 p.m. to 7 a.m.) are 10 dB louder than they really are. This 10 dB penalty is applied to account for greater sensitivity to nighttime noise, and the fact that events at night are often perceived to be more intrusive because nighttime ambient noise is less than daytime ambient noise. A lesser penalty is applied to evening noise levels (7 p.m. to 10 p.m.). The evening penalty is approximately 4.77 dB and likewise accounts for the greater sensitivity to noise in the evening.

Exhibit 4-16 – Population in 65 CNEL, by Scenario
(using 2007 Population counts)

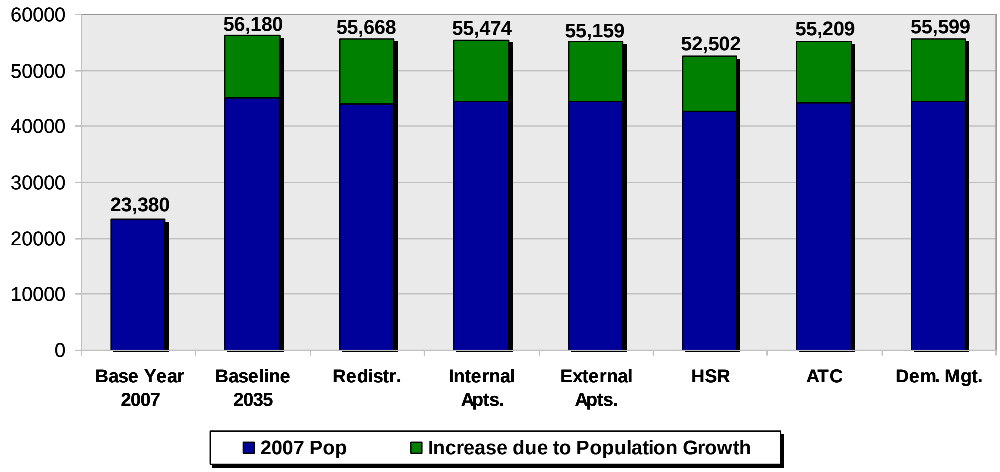


Notes: Change in population from 2007 Base year to 2035 Baseline results from forecast growth in aircraft operations.
Internal Airports includes increases in 65 CNEL populations at alternative airports due to diversion from primary airports.
Secondary airports include Sonoma County Airport, Buchanan Air Field, and Travis AFB.

The SFO contour accounts for 86 percent of the combined 65 CNEL population in the 2007 base year. The SFO share increases to 90 percent in the 2035 Baseline and ranges from 87 percent (Redistribution) to 92 percent (High-Speed Rail) for the 2035 scenario cases.

Exhibit 4-17 shows the future year 65 CNEL populations using forecast 2035 population data. When ABAG's policy projections are used to determine the residential population impacts, the noise-exposed population numbers are higher than the analysis based on 2007 population counts due to the reasons explained previously. With these population projections, the combined 65 CNEL population for the Bay Area airports more than doubles from 23,380 in 2007 to 56,180 in 2035. Of the total increase in population between 2007 and the 2035 Baseline, approximately 64 percent is due to the growth in aircraft operations. The remaining 34 percent of the increase is due to additional population in areas around airports and primarily around transit nodes that are assumed in the region's policies for developing more sustainable growth patterns over the long term.

Exhibit 4-17 – Population in 65 CNEL, by Scenario
(using 2035 Population Forecast)



Notes: Change in population from 2007 Base year to 2035 Baseline results from growth in aircraft operations and population.
Internal Airports includes increases in 65 CNEL populations at alternative airports due to diversion from primary airports.
Secondary airports Sonoma County Airport, Buchanan Air Field, and Travis AFB are included.

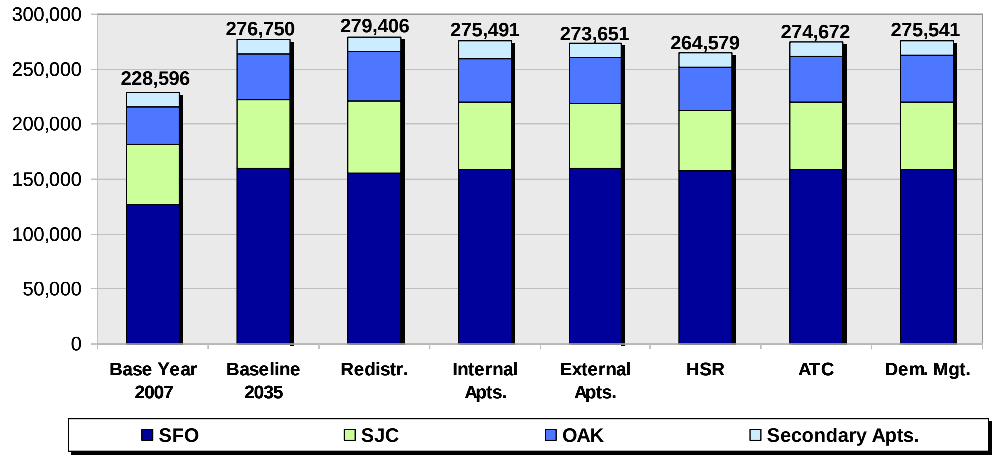
4.8.2 Population within 55 CNEL

For the Liveable Communities goal the population within the 55 CNEL was also examined, since airports can receive noise complaints from residents living in these areas as well. The 55 CNEL contours cover a larger area than the 65 CNEL contours. Consequently, the 2007 base year population count for the 55 CNEL is 228,596 compared to 23,380 for the 65 CNEL. Exhibit 4-18 shows the 55 CNEL populations for the base year and the future year cases based on 2007 population counts. From 2007 to the 2035 Baseline, the combined 55 CNEL population for the Bay Area airports increases by 21 percent based on 2007 population data.

The High-Speed Rail Scenario produces the lowest number of people in the 55 CNEL contour at 264,579, which is 4.4 percent lower than the 2035 Baseline. Redistribution increases the 55 CNEL population by one percent as the increases in activity and noise exposure at OAK and SJC more than off-set reductions at SFO. The other scenarios result in slightly lower population counts than the Baseline from 274,000 to 275,000.

SFO accounts for 56 percent of the combined 55 CNEL population in 2007 and between 56 and 59 percent in 2035. The secondary airports, i.e., Sonoma County, Travis and Buchanan, account for approximately 6 percent of the 55 CNEL population in 2035 in the Internal Secondary Airports Scenario and approximately 5 percent for the Baseline and all other scenarios.

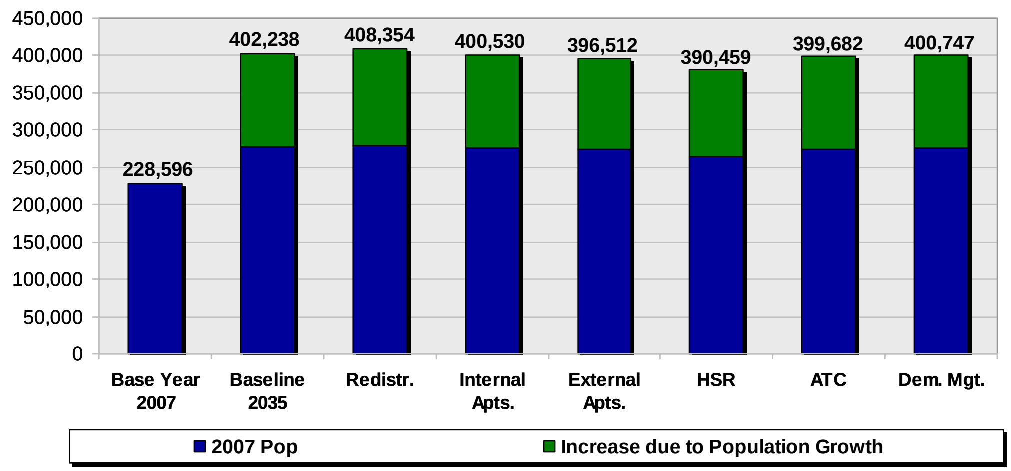
Exhibit 4-18 - Population in 55 CNEL, by Scenario *(using 2007 Population counts)*



Notes: Change in population from 2007 Base year to 2035 Baseline results from forecast growth in aircraft operations.
Internal Airports includes increases in 55 CNEL populations at alternative airports due to diversion from primary airports.
Secondary airports include Sonoma County Airport, Buchanan Air Field, and Travis AFB.

The effect of ABAG's policy population projections on the 55 CNEL is shown in Exhibit 4-19. If population increases projected for areas around airports are taken into account, the combined 55 CNEL population would increase by 76 percent from 228,596 in 2007 to 402,238 in 2035. Population growth in the area under the 55 CNEL contour accounts for 72 percent of the increase between 2007 and the 2035 Baseline, and aircraft operations growth accounts for the remaining 28 percent.

Exhibit 4-19 – Population in 55 CNEL, by Scenario *(using 2035 Population Forecast)*



Notes: Change in population from 2007 Base year to 2035 Baseline results from growth in aircraft operations and population.
Internal Airports includes increases in 65 CNEL populations at alternative airports due to diversion from primary airports.
Secondary airports Sonoma County Airport, Buchanan Air Field, and Travis AFB are included.

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5 Scenario Comparisons

5.1 Introduction and Special Considerations

This section summarizes the results of the mid-point screening analysis and compares how each individual scenario performs relative to the 2035 baseline and to each other in terms of each of the study goals. The results of this screening analysis are intended to provide input on the best options for accommodating future demand with minimal delays while minimizing environmental impacts and ensuring effective services. In the next phase of the study, individual scenarios will be combined into two to three scenarios for further analysis, which will ultimately inform the Vision and Implementation Plan and guide future decision making for the region's airports. Combining several alternatives into a single scenario is expected to produce even greater results than the results summarized here.

The analyses presented in this report are estimates of what each scenario might be able to achieve based on certain assumptions. While there are a number of uncertainties regarding the ultimate impacts of the individual scenarios, reasonable assumptions were made to assess the potential of each alternative. The assumptions relied not only on the expert judgment of the study team, but also on the guidance, input and review of several expert panels. As such, the analyses reflect reasonable and appropriate assumptions regarding the potential effectiveness and impacts of each scenario. Nevertheless, there is uncertainty that surrounds the potential impacts of each scenario as described below.

Redistribution and Use of Secondary Airports

Sources of uncertainty for the Redistribution, Internal Secondary Airports and External Airports Scenarios include future airline service decisions and passenger decisions regarding airport choice. While airline and passenger decisions can not be accurately predicted, it is reasonable to assume in the redistribution Scenario that passengers subject to high delays at SFO may respond by opting to use the less congested airports and that congestion at SFO may promote faster service development at OAK and SJC.

Regarding the use of secondary airports, airlines have significantly reduced capacity by downscaling or eliminating services at smaller secondary airports in the current airline operating environment. Use of Travis Air Force Base for commercial airline services would require a joint use agreement between Solano County and the U.S. Air Force. If airlines were to initiate services at the secondary airports, the ultimate success of those services would hinge on passenger acceptance of those airports as practical alternatives. However, all of the secondary airports included in the analyses currently receive airline service (i.e., the Sonoma County, Sacramento, Monterey, and Stockton airports) or were served by commercial airlines in the past (i.e., Buchanan Field and Travis).

Air Traffic Control Technologies

Whether or not the Air Traffic Control technologies analyzed are fully developed and deployed depends on many factors outside the direct control of RAPC. The timing and funding availability of the NexGen ATC technologies is uncertain. Furthermore, it is not clear that all airlines serving the Bay Area would equip their fleets to take advantage of the new technologies. Other sources of uncertainty involve private airline pilot and air traffic controller acceptance of new ATC procedures. Despite these uncertainties, the Air Traffic Control Technologies analyzed were recommended through careful consideration by the experts on the ATC Working Group panel and comprise a reasonable set of potential future technologies. In addition, RAPC and the airports can act to try and influence the funding and adoption of specific technologies that would benefit the Bay Area airports.

High-Speed Rail

The High-Speed Rail Scenario is subject to several uncertainties mainly relating to funding, the timing of implementation, fares, and a potential competitive response from airlines. The analysis is based on the latest ridership projections from the California High-Speed Rail Authority (CHSRA), which are subject to change from time to time based as assumptions are revised and new information becomes available.

Demand Management

There is only limited experience with demand management programs at U.S. airports. Administrative measures such as perimeter rules that limit airline flights to those within a certain radius of the airport are in place at New York La Guardia and Washington Reagan National, but these pre-date the 1990 Airport Noise and Capacity Act (ANCA) and are grandfathered restrictions.

In 1969, federal legislation imposed slot controls on several “high density” U.S. airports: New York LaGuardia, New York JFK, Newark, Washington Reagan National, and Chicago O’Hare. The rule was suspended at Newark in 1970 and in recent years the slot controls at the other New York airports and Washington Reagan have been relaxed. Through Air-21 legislation enacted in 2000, slots at O’Hare Airport were entirely phased out by July 1, 2002. However American and United significantly increased operations at O’Hare in 2004. FAA stepped in and through negotiations the carriers voluntarily reduced aircraft operations. Similar flight caps have been imposed by the FAA at the LaGuardia, Newark and JFK airports.

Boston Logan International Airport is the only airport with a demand management program based on differential pricing. The program at Logan is a pre-emptive program designed to alert airlines when the level of airline scheduling could result in average delays for three consecutive hours exceeding 15 minutes per operation. At that delay threshold, a surcharge of $150 per flight would be assessed to airlines operating during congested periods. The design of the program allows airlines to avoid incurring additional fees by voluntarily rescheduling or reducing operations at the airport.

The ultimate form of demand management at SFO and its effectiveness would be determined by the airport operator and would be subject to review and approval by the U.S. DOT. Nevertheless, the assumptions underlying the Demand Management Scenario provide a reasonable estimation of the potential effectiveness of demand management.

5.2 Screening Analysis Results

Exhibit 5-1 presents a stop-light matrix that compares the results of each scenario to the 2035 baseline for each of the study goals. There are four types of goals: goals related to aircraft delays (i.e., Healthy Economy and Reliable Runways); goals related to effective transportation options (i.e., Good Passenger Service); goals related to passenger ground access (i.e., Convenient Airports); and environmental goals (i.e., Climate Protection, Clean Air and Livable Communities).

For an individual goal, a green circle indicates that the scenario achieved "High" results, whereas a yellow circle indicates a "Medium" impact and a red circle denotes a "Low" impact. Results for the delay related goals were significantly greater than the results for the other goals. Therefore two different scales are used to measure scenarios performance. For the delay goals, a High performing scenario achieves delay reduction of 50 percent or greater; Medium performance is defined as a 15-49 percent delay reduction; and a Low performing scenario produces less than a 15 percent reduction in average delays. For the remaining goals, a High performing scenario produces a benefit of at least 10 percent. A scenario is ranked Medium if it produces a benefit of five to nine percent. A Low scenario produces a benefit of less than five percent.

5.2.1 Healthy Economy and Reliable Runways

The first two goals, Healthy Economy and Reliable Runways, are both measured in terms of average aircraft delays at SFO. The Air Traffic Control Technologies scenario ranks as the only High performing alternative for both the Healthy Economy and Reliable Runways goals. The Redistribution, High-Speed Rail and Demand Management Scenarios all produce lower, yet meaningful, delay reduction benefits. The two scenarios that include passenger diversion to other airports, the Internal Secondary Airports and the External Airports Scenarios, achieve less than a 15 percent reduction in SFO aircraft delays and thus are ranked as Low performing alternatives.

Exhibit 5-1 – Comparison of Screening Analysis Results by Alternative

	Goal:						
Scenario:	**Economy**	**Reliable Runways**	**Good Service**	**Convenient Airports**	**Climate Protection**	**Clean Air**	**Livable Communities**
Metric:	*Average Aircraft Delay*	*Average Aircraft Delay*	*Flight Frequency in Top 15 O&D Markets*	*Average Ground Access Time*	*Green House Gases (CO2)*	*Hydrocarbons (Nox+VOCs)*	*Population in 65 CNEL*
Redistribution	🟡	🟡	🔴	🔴	🔴	🟡	🔴
Internal Airports	🔴	🔴	🟡	🔴	🔴	🟡	🔴
External Airports	🔴	🔴	🔴	🔴	🔴	🔴	🔴
High-Speed Rail	🟡	🟡	🟢	🔴	🟡	🟢	🟡
ATC Technologies	🟢	🟢	🔴	🔴	🔴	🔴	🔴
Demand Mgmt	🟡	🟡	🔴	🔴	🔴	🔴	🔴

Impact vs. Baseline	Improvement Criteria	
	Aircraft Delay	All Other
🟢 High Impact	>= 50%	>= 10%
🟡 Medium Impact	15 to 49%	5 to 9%
🔴 Low Impact	< 15%	< 5 %

Notes: Climate Protection, Clean Air and Livable Communities exclude impacts of trains in High-Speed Rail Scenario

Good Passenger Service

For the Good Passenger Service goal, High-Speed Rail performs the best with a 10 percent increase in "service frequencies" in the region's top 15 domestic O&D air passenger markets. Internal Airports, which results in a net increase in services in the region's top air travel markets, is the next best scenario, with a Medium ranking for Good Passenger Service. All other scenarios have a Low impact on the service goal.

Convenient Airports

Results for the Convenient Airports goal are summarized in terms of the average airport ground access time, although the results would be similar for the average airports ground access distance measure. None of the scenarios have a meaningful impact on the overall average airport ground access time, though the Internal Secondary Airports Scenario could significantly reduce airport ground access times for the passengers in the secondary airport market areas. based on the overall average ground access time, all scenarios are ranked as Low performers against this goal.

Climate Protection

High-Speed Rail is the best performing scenario for the Climate Protection goal with a Medium ranking. With HSR service in the CA corridor, aircraft operations at the primary airports fall by 6 percent and GHGs (measures as CO_2 emissions) decline by 8 percent. The analysis of GHG emissions does not consider emissions from the high-speed trains, because only 15 percent of forecast HSR passengers are diverted from air while the great majority is diverted from automobiles. However, a sensitivity analysis of GHG emissions per passenger mile indicates that a net reduction in GHG is likely to occur. All other scenarios ranked as Low performers for Climate Protection.

Clean Air

High-Speed Rail also produces the greatest reduction in aircraft and ground vehicle emissions (measured as total hydrocarbons and nitrogen oxides – precursors for ozone). It produces a 10 percent reduction in emissions and thus ranks as a High performing scenario for the Clean Air goal. Redistribution and Internal Airports lower hydrocarbons by 7 and 5 percent, respectively, and rank as Medium. These scenarios shift demand to other airports (i.e., the secondary airports, OAK or SJC) where flights are operated with smaller aircraft or with less delay which results in a net reduction in hydrocarbon emissions. External Airports, Demand Management and ATC produce minimal reductions in air emissions and rank as Low performing scenarios for the Clean Air goal.

Livable Communities

The results summarized for the Livable Communities goal are based on the 65 CNEL population analyses using estimated 2007 population data. High-Speed Rail, which results in the greatest reduction in aircraft operations, is the highest performing scenario for this goal. The shift from air to rail reduces the combined 65 CNEL population by 5 percent resulting in a Medium rating for the High-Speed Rail Scenario. All other scenarios ranked as Low performers for the Livable Communities goal.

In summary, High-Speed Rail is the best performing scenario for the passenger service and environmental goals. However, the Air Traffic Control Scenario is rated highest in terms of aircraft delay reduction. Redistribution, Demand Management and High-Speed Rail also provide meaningful delay reduction benefits, but minimal environmental benefits.

5.3 NEXT STEPS

In the next phase of the study, the individual strategies evaluated in this report will be combined into 2-3 scenarios for further analysis. Combinations of the alternatives are expected to result in better performance for all the study goals compared to their individual results. The results of the analyses for the 2-3 new scenarios along with the results from the original set of scenarios will be used to develop RAPC's Vision and Implementation Plan for Bay Area airports.

REGIONAL AIRPORT SYSTEM PLAN UPDATE –
BASELINE RUNWAY CAPACITY AND DELAYS REPORT

Prepared for:

Regional Airport Planning Committee

Prepared by:

Flight Transportation Associates

August 2010

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1. INTRODUCTION

1.1 Project Overview

The Regional Aviation System Plan (RASP) serves as the San Francisco Bay Area's overall policy document for aviation planning by identifying the region's future airport demand and capacity needs and articulating strategies for accommodating future aviation demand. The goals of this Regional Airport System Planning Update are to:

- Identify and analyze the effectiveness of alternative strategies for accommodating the Bay Area's long-term aviation demand without constructing additional runways at the primary airports;
- Involve stakeholders and the public to aid in building a regional consensus on how to respond to congestion at the primary Bay Area airports; and
- Assist the Regional Airport Planning Committee (RAPC), an advisory committee to the Metropolitan Transportation Commission (MTC), the Association of Bay Area Governments (ABAG) and the Bay Conservation and Development Commission (BCDC), in developing a vision and implementation plan for the region's aviation system.

To accomplish these goals, the current study must address three critical questions:

- What are the capacity limits of the primary Bay Area airports?
- When are these capacity limits likely to be reached?
- What strategies offer the greatest potential to allow the region to efficiently accommodate future aviation demand?

1.2 Role and Scope of the Baseline Capacity Analysis

The purpose of the baseline capacity analysis is to determine when each of the primary airports will reach their airfield capacity limits. Airfield capacity for each of the primary airports was estimated for the base year (2007) and each future analysis year (2020 and 2035). Together airfield capacity and demand, as measured by actual and forecast aircraft operations, determines airfield delay hours for the base year and forecast years. It is important to note that the baseline capacity analysis only considers airfield constraints.

The results of the baseline capacity analysis will ultimately serve as the basis for assessing the capacity enhancing benefits of the various alternative strategies that will be analyzed in the Target Analysis. These include the implementation of High Speed Rail (HSR), redistribution of traffic among the primary airports, greater use of secondary airports, the deployment of new air traffic control (ATC) technologies, and potential demand management strategies. The airfield delays associated with the implementation of each strategy will be measured against the baseline delays to determine the effectiveness of each potential strategy.

The capacity and delay analysis considered all operations at each airport, including commercial airline and general aviation flights, since they may share the use of runways and are managed together by the FAA. The analysis was focused solely on runway capacity and delays. Airspace or landside constraints were not included in the capacity analysis. Only airspace issues within the immediate vicinity of the airport were considered. The modeling reflects existing conditions and does not consider potential airfield improvements or ATC enhancements.

All assumptions and parameters were developed with input and consultation from the FAA and airport personnel. The consultant team reviewed existing studies and interviewed FAA personnel at the Air Traffic Control Towers (ATCT) for each airport as well as the (NORCAL TRACON) to identify the patterns of runway use and major constraints at each airport. The consultant team also coordinated with airport planning and operations personnel who provided guidance and critical data inputs. Airport personnel also reviewed and provided valuable comments on the final results. Finally, the methodology and assumptions were presented and discussed in a technical Working Group of experts convened by MTC.

2. METHODOLOGY

2.1 Overview

The runway capacities of the three major Bay Area commercial service airports have been extensively studied by the airports in the course of updating the airport Master Plans and by the FAA as part of its airport capacity benchmarking project and Future Airport Capacity Task (FACT) study. The consultant team reviewed these studies and supplemented them with visits to each airport and discussions with airport operations personnel and with FAA air traffic controllers.

Runway constraints fall into four areas: airport geometry (e.g., number of runways, lengths, orientation, and exits), operating procedures (e.g., ATC rules and instrumentation), weather (e.g., historical data on IFR conditions) and user characteristics (e.g., airline schedules and fleet mix). The constraints are summarized for all airports in the following report. The airport data were used to identify those runway configurations (i.e. combinations of runways and weather conditions) to be analyzed in this study.

The goal of the Regional Aviation System Planning Analysis update is to identify effective regional approaches for accommodating future aviation demand from a myriad of possibilities; it does not require the same level of modeling sophistication that projects such as an EIS may require. TAAM and SIMMOD are two detailed simulation models designed to examine the full range of airport activity including gates, taxiways, runways and airspace. These models require a considerable amount of effort to prepare the data for each airport and to validate the results. For this study the consultants have selected a more appropriate simulation model, Flexible Airport Simulation (FLAPS), which examines just runways and final approach. Compared to TAAM or SIMMOD, FLAPS is simpler to set up and it executes very quickly. The DELAYSIM model was then used to estimate runway use and delays based on the configuration capacities, hourly airport demand and 10 years of weather data.

Operational capacities for each runway configuration and weather condition were calculated using FLAPS with the appropriate aircraft fleet mix for the airport and analysis year. A separate hourly demand profile was calculated for jet and non-jet activity for an average weekday, Saturday and Sunday, using radar flight track data. Monthly adjustment factors were calculated from tower counts of aircraft operations.

Delays were calculated by DELAYSIM using 10 years of hourly weather data, the hourly demand profile for the relevant month and day of week, and the runway configuration with the highest capacity for the prevailing wind strength and direction, given the allowable tailwind and crosswind criteria. If the demand exceeds the airport capacity in any given hour then a queue forms and the unmet demand spills to subsequent hours. The delay in any given hour is assigned to the weather condition and runway configuration in effect for that hour.

Allowable tailwind and crosswind criteria are different for dry and wet runways. The runways were assumed to be wet if there was more than 0.01 inches of precipitation in the previous hour. However, this may sometimes overstate the duration of wet runway conditions and hence understate the runway capacity during the hour. Similarly, the average wind strength and direction from each weather observation in a given hour was assumed to remain in effect for the entire hour.

2.2 Capacity Model – FLAPS

The Flexible Airport Simulation (FLAPS), which FTA developed with the Flight Transportation Laboratory of the Massachusetts Institute of Technology, is an event-driven Monte Carlo simulation that models aircraft operations from the terminal entry fix[1] to the runway exit and from the runway departure queue to the departure fix. In this study, FLAPS is used principally to provide estimates of runway capacity. Model inputs include detailed representations of the three primary factors that affect capacity:

- Aircraft characteristics and fleet mix
- Runway layout and availability
- Air traffic control operating procedures

Fleet mix requirements include estimated number of operations by aircraft type. For computational efficiency, individual aircraft types are grouped into similar classes based on operating requirements and performance characteristics; these include runway lengths for takeoff and landing, engine types (jet versus propeller), and FAA aircraft weight classes. FLAPS utilizes eighteen aircraft classes (nine arrival and nine departure) with distinct operating characteristics including approach speed, float and braking distances, and departure runway occupancy time. The fleet mix affects runway capacity because different classes of aircraft have different runway occupancy times and in-flight separation requirements.

Runway layout input requirements include the orientation and length of each runway and the location and type (e.g., high speed) of runway exits and intersections.

Air traffic control inputs include a range of operational factors such as the runways in use at specified times and their modes (e.g., arrival only, mixed arrivals and departures, departure priority), runway assignment policy (e.g., by aircraft type, by direction of flight, etc.), and the required separations (arrival-arrival, departure-departure, departure-arrival) between successive aircraft operations under different weather conditions. Separation standards are a critical element of runway capacity calculations, and FLAPS is

[1] Each airport has several arrival fixes, which vary in distance from the airport but are typically around 25 nm out. These help ATC route arrivals from different origins to the landing runway approach path. In addition, each airport has a set of departure fixes to help ATC route the flow of takeoffs from the runways to the enroute environment.

uniquely designed to accurately apply appropriate separations for single runways as well as multiple intersecting or non-intersecting runways. FLAPS utilizes other air traffic control variables including the location of final approach fixes, land-and-hold-short operations, traffic distribution by arrival and departure fix, etc.

The combinations of physical runway layouts and air traffic control procedures are used to define various runway configurations. Each configuration consists of a single runway or set of runways in use and the air traffic control variables in effect at that time. In order for DELAYSIM to simulate operations accurately over the course of a year, every feasible runway configuration should be defined and its capacity estimated. Variations in air traffic control procedures, active runways, and weather conditions require subsets of the primary runway configurations. Due to budget constraints, the number of configurations examined in this study was limited to the most frequent operating situations at the three Bay Area commercial airports.

For this regional analysis , the primary output of each FLAPS model run is the saturation capacity of a runway configuration, with saturation capacity defined as the maximum number of aircraft arrivals and departures that can be achieved in one hour under given fleet mix, weather, and air traffic control conditions. Saturation capacity implies a high workload and no distractions for controllers, and it exceeds the level of activity that controllers can sustain for prolonged periods of time. Operational capacity, approximated as 90 percent of saturation capacity, represents the long-term operating levels which controllers achieve in practice.

2.3 Delay Model -- DELAYSIM

DELAYSIM is a unique model developed by FTA to simulate how air traffic controllers might use the airport’s runways based on specified demand characteristics and actual weather observations. It predicts hour-by- hour runway utilization, and estimates the associated aircraft delays.

DELAYSIM operates by sequencing through ten years’ of hourly weather observations and simulating the controllers’ selection of runway for each hour. It averages the results to produce annual operating statistics. For each hour, the runway selection is a three-step process. DELAYSIM first identifies from all possible runway configurations those which are available based on the wind, visibility and ceiling conditions. Second, the model identifies which (if any) of the available configurations has sufficient operational capacity to meet the demand in the current hour. If none of the configurations has sufficient capacity, the available configuration with the highest capacity is chosen. Third, if more than one configuration has enough capacity DELAYSIM selects the configuration that best meets the specified criteria which normally is based on airport noise goals, taking into account controller workload for runway changes. DELAYSIM also has the capability of selecting the available configuration with the maximum capacity in each hour, which normally would represent the controllers’ unconstrained preference. The maximum capacity option was used in this analysis.

Once DELAYSIM selects a runway configuration, it calculates delays by comparing the saturation capacity of that configuration with the projected hourly demand using a queuing theory model. DELAYSIM captures all delays in its statistics, not just those operations delayed by more than 15 minutes (although those delays are identified). In addition, DELAYSIM assumes that all scheduled demand will eventually be handled. In other words, DELAYSIM does not cancel operations, it simply delays them until they can be accommodated. For this reason, the hours of delay generated by DELAYSIM are not necessarily comparable to other models or FAA measures, and must be compared to a baseline condition to get a true measure of delay impacts. Stated another way, DELAYSIM includes the impacts of cancelled flights by estimating the additional delays that such flights would experience if they were to be completed.

In addition to producing delay statistics, DELAYSIM generates configuration utilization statistics that are used to evaluate changes in airport operational activity under different scenarios.

2.4 Estimation of Annual Airport Capacity

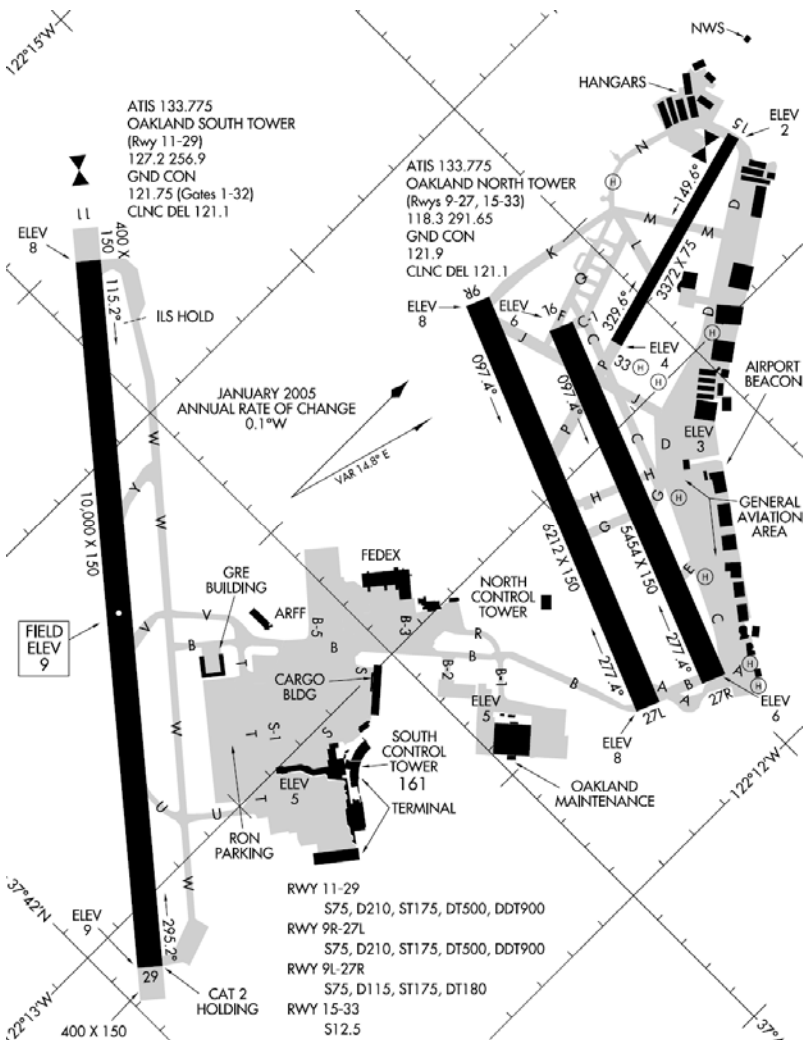
One of the objectives of the baseline capacity and delay analysis summarized in this report is to estimate when each airport might reach its practical annual capacity. Average delay per aircraft operation is a conventional metric for overall aircraft congestion. The FAA uses 15 minutes as a trigger point for reporting delays and this value is frequently used by airports for determining congested operations. However, the appropriate level of delay is really a policy decision for the airport operator, and it may vary depending on the type of activity at the airfield. For hub airports with international flights and longer turnaround times, the 15-minute average may be appropriate. But for airports with a high percentage of low-cost carriers which provide frequent service and require quick aircraft turnaround times, a lower value may be more appropriate. For this regional analysis, we have used a range of 12 to 15 minutes for all airports to estimate the level of operations that will constitute the airport's ultimate capacity.

3. METROPOLITAN OAKLAND INTERNATIONAL AIRPORT (OAK)

3.1 Airport Configuration

Oakland International Airport is unusual in that it has two somewhat independent elements: the South Field (Runway 11-29), which handles most of the commercial activity; and the North Field (Runways 9L-27R, 9R-27L and 15-33), which handles most of the general aviation (GA) flights as well as some cargo and air taxi operations. Nearly all of the commercial jet operations use the South Field, because of the longer length of Runway 11-29 while most GA jet operations to or from the west to use the South Field because of a local noise ordinance.

Exhibit 3-1: Layout of Oakland International Airport (OAK)



3.2 Runway Capacity

The FLAPS model, as described in Section 2, was used to estimate the runway capacity of OAK under various operating conditions. The following sections discuss modeling assumptions, the runway configurations modeled and the capacity results. The capacity analysis for OAK was based on the airfield layout, operating conditions and demand distribution for 2007. Although the Port of Oakland has examined a number of potential airfield and airspace improvements, none of these has been implemented and therefore, none were included in the analysis.

3.2.1 Fleet Mix Assumptions

The level of aircraft operations and the mix of aircraft types assumed for each analysis year is based on the actual and forecast activity data presented in the *Baseline Aviation Activity Forecasts* report for OAK. Actual aircraft activity for 2007 and forecast activity for 2020 and 2035 include general aviation, air passenger and air cargo operations at the North and South Fields. For the capacity analysis, operations by aircraft type were summarized into nine aircraft classes, which distinguish operations by aircraft size and airfield. (See Exhibit 3-2) Large jets, which have a maximum take-off weight between 41,000 and 255,000 pounds, account for an increasing share of the fleet at OAK, rising from 43 percent in the base year to 52 percent in 2035. Small propeller aircraft, which are projected to decline over the forecast period, account for 27 percent of activity in 2035 compared to 40 percent in 2007.

Exhibit 3-2: Summary of Base Year and Forecast Fleet Mixes for OAK

ID	Aircraft Class	2007	2020	2035
SP	Small props –North Field	40.1%	28.9%	26.6%
SJ	Small jets –South Field and/or North Field	3.0%	3.9%	4.2%
LP	Large props – North Field	1.0%	1.3%	1.2%
TP	Turboprops – South Field and/or North Field	0.9%	1.1%	1.1%
BJ	Business jets - South Field and/or North Field	2.6%	3.0%	3.6%
RJ	Regional jets – South Field	3.4%	4.0%	4.7%
LJ	Large jets –South Field	43.1%	49.3%	51.5%
5J	757s – South Field	0.8%	1.7%	0.3%
HJ	Heavy jets – South Field	5.1%	6.9%	6.9%

Notes: Small aircraft - ≤ 41,000 lbs
Large aircraft - >41,000 lbs and ≤ 255,000 lbs.
Heavy aircraft - > 255,000 lbs

Source:Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009.

3.2.2 Runway Configurations Modeled

Eight configurations, consisting of runway and weather condition combinations, were modeled for OAK to represent operations under east and west flow for three weather conditions:

- VAPS – good Visual Flight Rule (VFR) weather with ceilings at or above 4,500 ft and visibility at or above 5 nautical miles (nm).
- MVFR – marginal VFR weather below VAPS but with ceilings at or above 1,000 ft and visibility at or above 3 nm. Due to the fact that many GA flights in small aircraft do not operate in these weather conditions, forecast operations in small propeller aircraft were reduced to 40 percent of the VAPS levels in MVFR conditions.
- IFR – Instrument Flight Rule (IFR) conditions with ceilings below 1,000 ft or visibility below 3 nm. For normal Instrument Landing System (ILS) operations, ceilings must be at or above 200 ft and visibility above 0.5 nm. For west flow, two additional IFR configurations were included: ILS Cat II (with a minimum ceiling of 100 ft and visibility of 0.33 nm) and ILS Cat III (with a minimum ceiling of zero and zero visibility). Since most GA flights do not operate in IFR, the small props in the fleet mix were reduced to 5 percent of the VAPS levels.

West Flow – VAPS

For the west Flow-VAPS configuration the active runways are Runway 29 on the South Field and Runways 27L/27R on the North Field, all of which are modeled as mixed mode (both arrivals and departures). Although Runway 15-33 is also available for operations, it was not modeled since the 27L/27R runways have more than sufficient capacity for accommodating the GA demand on the North Field.

In this configuration, piston driven propeller aircraft are assigned to Runways 27L/27R for arrival and takeoff. Turbo-props and small business jets are allowed to use Runways 27L/27R or Runway 29. Large business jets can use any of the three runways for arrival, but are required to depart on Runway 29. All commercial jets use Runway 29 for arrival or takeoff. Standard IFR separations for single-runway arrival-arrival, arrival-departure and departure-departure operations were reduced for each runway in this configuration. Since pilots can see other traffic around them in good weather conditions, the standard IFR separation minimums can be safely reduced.

West Flow – MVFR

The runway assignments for the West Flow-MVR configuration are the same as the runway assignments for the West Flow-VAPS configuration, described above. For the West Flow-MVFR configuration, the arrival-arrival separations were increased to standard IFR values.

West Flow – IFR

For the West Flow-IFR configuration, piston-powered propeller aircraft depart on Runway 27L and arrive on Runway 27R. Turboprops and small business jets can arrive on Runway 27R or Runway 29, and depart on Runway 27L or Runway 29. Large business jets must depart on Runway 29 but can arrive on Runways 27R or 29. All commercial jets use Runway 29 for arrival and departure. Standard single-runway IFR separations were applied to each runway, and between Runways 29, 27L and 27R. The two additional West Flow-IFR configurations, the ILS Cat II and Cat III configurations, were adapted from another study which assumed increases in arrival-arrival separations and reductions in operations, since many small propeller-driven aircraft and some larger aircraft do not have the necessary instrumentation for operating in Cat II or Cat III weather conditions.

East Flow – VAPS

The active runways for the East Flow-VAPS configuration are Runway 11 on the South Field and Runways 09L/09R on the North Field, all of which are modeled as mixed mode (both arrivals and departures). Although Runway 15-33 is also available for operations, it was not modeled since Runways 09L/09R have more than sufficient capacity for accommodating the GA demand on the North Field.

For this configuration, piston driven propeller aircraft are assigned to Runways 09L/09R for arrival and takeoff. Turbo-props and small business jets are allowed to use Runways 09L/R or 11. Large business jets can use any of the three runways for departure, but are required to arrive on Runway 11. All commercial jets use Runway 11 for arrival or takeoff. Reduced single-runway arrival-arrival, arrival-departure and departure-departure separations were applied for each runway to reflect aircraft separations in good weather conditions.

East Flow – MVFR

The runway assignments for the East Flow-MVFR configuration are the same as the runway assignments for the East Flow-VAPS configuration, as described above. The arrival-arrival separations for the East Flow-MVFR configuartion were increased to standard IFR values.

East Flow – IFR

All arrivals use Runway 11 in the East Flow-IFR configuration. Piston powered propellers depart on Runway 09L. Turboprops and small business jets can depart on Runway 09L or Runway 11. Large business jets and all commercial jets must depart on Runway 11. Standard IFR departure-departure separations were applied to Runway 11; and between Runways 09L and 11. The arrival-arrival separations for Runway 11 were extended to provide time for 11 departures to taxi from the ILS hold point to the runway end.

3.2.3 Results

The results of the capacity analysis for each of the analysis years are shown in Exhibit 3-3. The values presented in the *Arrive*, *Depart* and *Saturation* columns are the maximum hourly throughput or saturation capacities for the airfield under balanced flow (i.e., equal numbers of departures and arrivals). The *Operational* column is 90 percent of the saturation capacity, based on the FAA's former method of estimating their Engineered Performance Standards for an airport. Generally, an airport's acceptance rate will lie between the theoretical Operational and Saturation capacities. For comparison, the current maximum arrival and departure acceptance rates at OAK, based on information provided by FAA's Northern California TRACON (NorCal), are shown in the final two columns.

Exhibit 3-3: Estimated Base Year and Forecast Runway Capacities for OAK

			Arrive			Depart			Capacity		NorCal	
	Flow	Weather	29	27L	27R	29	27L	27R	Saturation	Operational	Arr	Dep
2007	West	VAPS	26	19	13	31	14	14	117	105	58	80
	West	MVFR	27	7	3	27	5	5	74	67	35	80
	West	IFR	26		5	28	3		62	56	35	40
	West	Cat II	24			24			49	44		
	West	Cat III	22			22			43	39		
			11	09R	09L	11	09R	09L	Saturation	Operational	Arr	Dep
	East	VAPS	24	14	4	22	10	10	84	76	40	80
	East	MVFR	23	5	3	22	5	5	63	57	30	80
	East	IFR	25			20		5	50	45	25	40
2020			29	27L	27R	29	27L	27R	Saturation	Operational	Arr	Dep
	West	VAPS	26	15	8	32	9	9	99	89	58	80
	West	MVFR	27	4	3	27	4	3	68	61	35	80
	West	IFR	24		6	27	3		60	54	35	40
	West	Cat II	24			24			49	44		
	West	Cat III	22			22			43	39		
			11	09R	09L	11	09R	09L	Saturation	Operational	Arr	Dep
	East	VAPS	24	11	4	25	7	7	78	70	40	80
	East	MVFR	23	4	2	23	4	2	58	52	30	80
	East	IFR	24			21		4	49	44	25	40
2035			29	27L	27R	29	27L	27R	Saturation	Operational	Arr	Dep
	West	VAPS	27	14	7	31	8	8	95	86	58	80
	West	MVFR	27	4	3	26	4	3	67	60	35	80
	West	IFR	24		6	27	3		60	54	35	40
	West	Cat II	24			24			49	44		
	West	Cat III	22			22			43	39		
			11	09R	09L	11	09R	09L	Saturation	Operational	Arr	Dep
	East	VAPS	25	10	4	25	7	7	78	70	40	80
	East	MVFR	24	3	2	21	3	3	56	50	30	80
	East	IFR	25			20		5	50	45	25	40

3.3 Runway Delays

The DELAYSIM model, as described in Section 2, was used to estimate the runway delays. In addition to the hourly capacity inputs presented above, the DELAYSIM model also requires information on hourly weather observations, an hourly aircraft demand profile and the airport's wind rule.

3.3.1 Weather Assumptions

The delay modeling was based on 10 years of hourly weather data for the period 1998 to 2007. The hourly weather observations for OAK were obtained from the National Weather Service and included the following parameters as inputs to the DELAYSIM model:

- Date and time
- Wind speed and direction
- Ceiling
- Visibility
- Precipitation

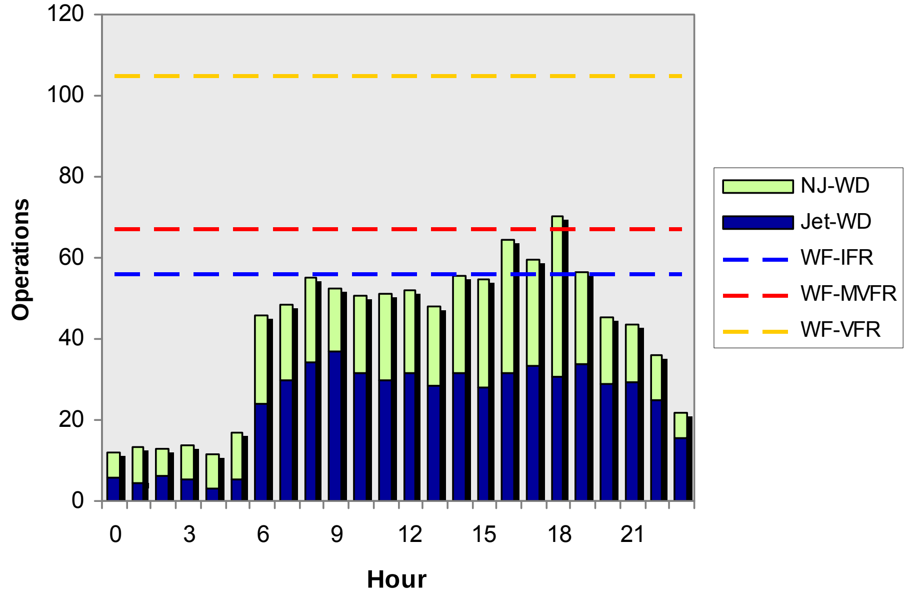
The weather data were processed to estimate missing values of some parameters, and to adjust the reported precipitation to the prior hour when it actually occurred. When more than one observation was reported in an hour, the average (wind speed and direction) or minimum (ceiling and visibility) was selected. In a few cases, where no weather observation was recorded, those hours were not modeled.

3.3.2 Hourly Demand Assumptions

The hourly distribution of aircraft demand is a key variable in estimating airfield delays. Radar tracking data for 2007 was used to estimate the hourly aircraft demand profiles for the base year. Separate profiles were developed for jets and non-jets, each for the average weekday, Saturday and Sunday. In addition, a monthly profile was developed to adjust the average profiles throughout the year. It should be noted that these profiles represent the total demand, including both arrivals and departures.

Exhibit 3-4 compares the jet and non-jet profiles for an average weekday in 2007 for both the North and South Fields combined. Exhibit 3-5 compares the total (jet plus non-jet) 2007 profiles for the average weekday, Saturday and Sunday. Exhibit 3-6 presents the variation in average demand by month of the year.

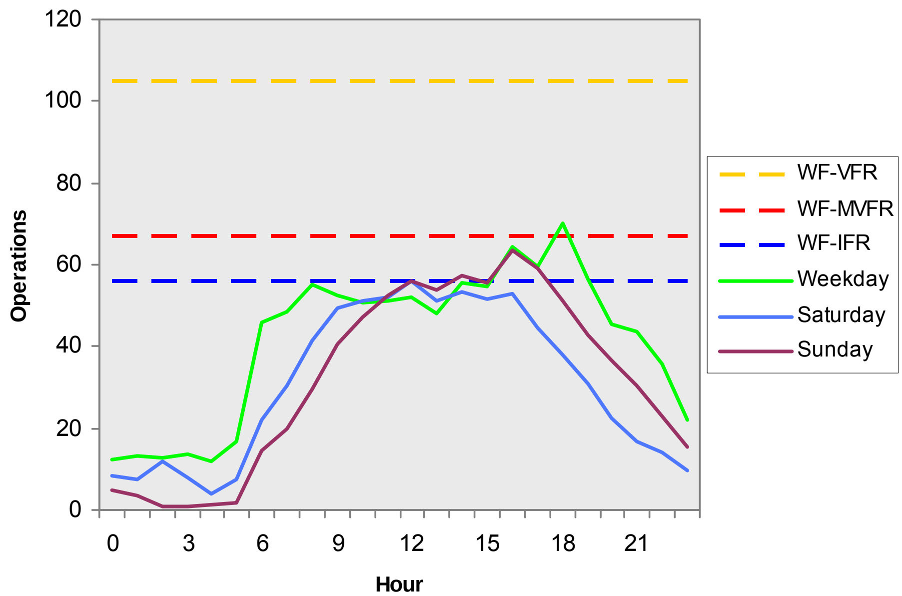
Exhibit 3-4: Jet and Non-Jet Operations per Hour at OAK, 2007 Average Weekday



Note: NJ-WD – non-jet weekday
Jet-WD – jet weekday

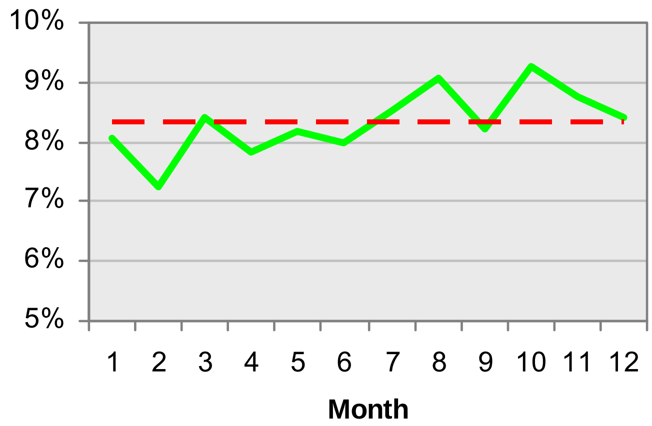
Source: Radar data.

Exhibit 3-5: Total Operations per Hour at OAK, 2007 Average Weekday, Saturday and Sunday



Source: Radar data.

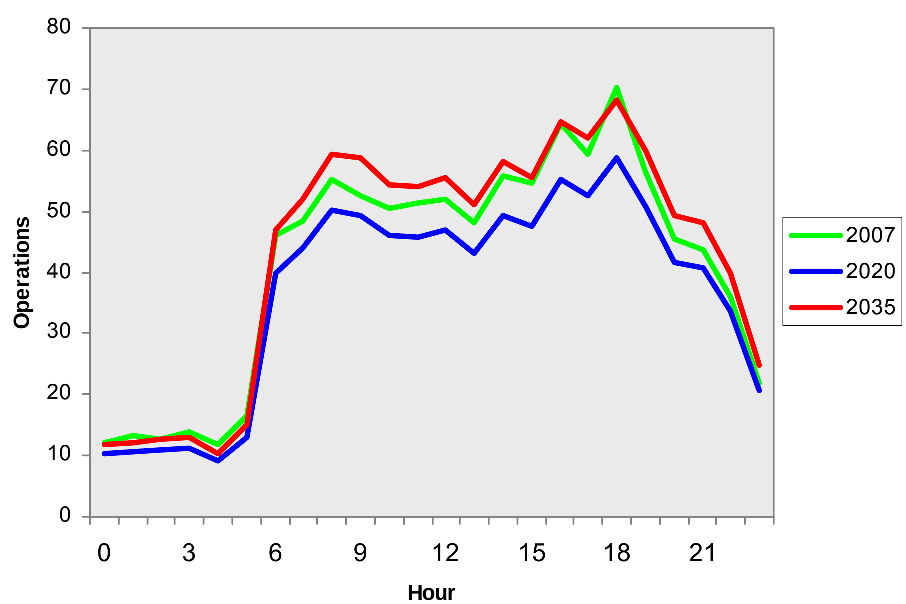
Exhibit 3-6: Monthly Variation in Average Demand at OAK, 2007



Source: Radar data.

The 2007 demand profiles for jet and non-jet operations were applied to forecast jet and non-jet operations for 2020 and 2035 to estimate future year demand profiles. Exhibit 3-7 compares the 2007 average weekday profile with those for 2020 and 2035. The 2020 profile is well below that for 2007 due to the forecast decline in GA activity. Total demand in 2035 is higher than that in 2007, but the peak is slightly lower.

Exhibit 3-7: Comparison of Average Weekday Operations per Hour, Base Year 2007 vs. Forecast 2020 and 2035



Source: Radar data.
Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009.

3.3.3 Wind Rule Assumptions

The selection of available runways for each hour modeled depends on the weather conditions for that hour. The local wind rule specifies the maximum allowable crosswind and tailwind components in knots depending on whether the runway is dry or wet. Exhibit 3-8 summarizes the wind rule assumptions for OAK.

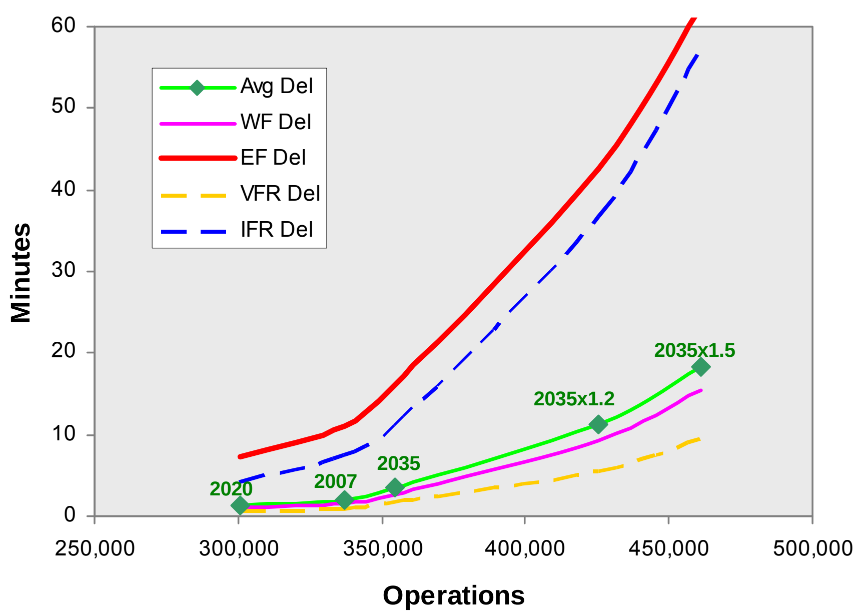
Exhibit 3-8: OAK - Maximum Allowable Crosswind and Tailwind Components, In Knots

	Dry	Wet
Crosswind	20	15
Tailwind	7	0

3.3.4 Estimated Average Aircraft Delays

DELAYSIM was run for the three analysis years: 2007, 2020 and 2035. The average aircraft delay for 2035 was only 3.5 minutes, well below the capacity threshold of 12-15 minutes, so the 2035 demand was scaled up by 20 percent, 30 percent and 50 percent to estimate when delays at OAK may become congestive. Exhibit 3-9 presents the average aircraft delay for these scenarios. In addition to the average delay shown in green, the figure also shows the average delay for East and West flow and for VFR and IFR conditions. The average delay for West Flow is only slightly lower than the overall average since this is the predominant operating condition. However, the delays for IFR and for East Flow are considerably higher than the overall average.

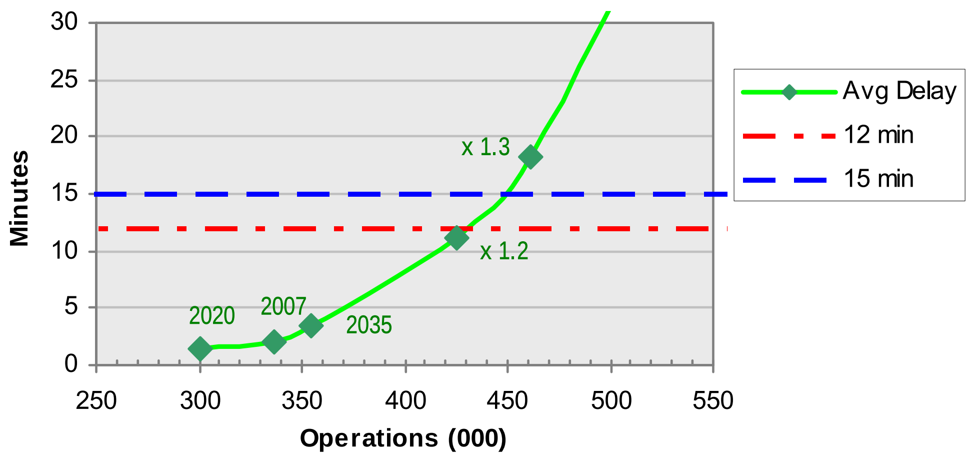
Exhibit 3-9: Base Year and Forecast Average Aircraft Delay at OAK



3.3.5 Estimated Airfield Capacity

Exhibit 3-10 presents the average aircraft delay at OAK with the delays of 12 and 15 minutes indicated. The practical annual capacity of OAK (including North Field and South Field operations) is estimated to be between 420,000 and 450,000 annual operations with the forecast fleet mix. The airport staff has suggested that a lower delay value of 8 minutes may be more appropriate for determining capacity due to the types of operations conducted by airlines using OAK. If this value is used, the airport's capacity would be approximately 400,000 annual operations. Using either criteria for delay, capacity would not be reached until after 2035.

Exhibit 3-10: Base Year and Forecast Aircraft Delays at OAK – Average Minutes of Delay vs. Annual Aircraft Operations



Airfield capacity issues at OAK stem from the single runway on the South Field which is used by nearly all commercial flights. The three runways on the North Field have restrictions on turbojet operations and are used almost exclusively by general aviation and some charter and cargo flights. When the Bay Area is operating in West Flow under VFR conditions (about 70% of the time), OAK has adequate capacity today and through 2035. According to the forecast for OAK, traffic growth is not projected to be a significant issue in the future. However, when the weather conditions deteriorate at OAK, the delays start to build up to unacceptable levels, particularly when winds force the airport to operate in East Flow (See Exhibit 3-9). East Flow occurs about 7% of the time, and when the weather drops below VFR the capacity is severely reduced. A significant issue here is the current location of the ILS Glide Slope antenna which requires departures to hold well back from the runway threshold while a landing is underway. This situation can be alleviated by moving the Glide Slope antenna or by using future GPS technology, as described in the Analysis of Advanced ATC Concepts.

3.4 Comparison with Oakland Capacity Report

The Port of Oakland commissioned an *Ultimate Airfield Capacity Study* (Jacobs study) which was completed in 2009[2]. Due to its contemporary release with this study, it was reviewed for similarity of results. However, the assumptions and methodology employed in the Jacobs study were vastly different from those utilized in the RASP Update, so direct comparisons are not possible. Nonetheless, the conclusions of both studies regarding the ultimate capacity of OAK are quite similar despite these differences. The Jacobs study predicts the ultimate OAK capacity to be 450,000 annual operations, whereas this study results in a range of 425,000 to 450,000 annual operations.

Some of the most significant differences between the two studies are summarized below:

- The Jacobs study results reflect the Master Plan improvements—including a new terminal, a proposed high-speed exit on Runway 29, taxiway improvements to expedite Runway 29 departures, and removal of the ILS hold point for Runway 11 under IFR conditions. These improvements would have a beneficial impact on airfield delays in the Jacobs analysis.
- The Jacobs simulations included taxiway and apron maneuvering as well as airspace issues. The RASP Update study only analyzes runway delays so aircraft activity beyond the runway on the ground or beyond the arrival and departure fixes in the air was not considered. The taxiway delays are relatively small, but it is difficult to assess how much the airspace delays contribute to the final results in the Jacobs study.
- Jacobs simulated four runway/weather configurations, each for 24 consecutive hours. A weighted average of the results of each was used to estimate annual delays based on composite annual weather statistics. The RASP Update study analyzed eight runway/weather configurations and used ten years of actual weather observations. IFR weather rarely lasts for 24 consecutive hours but normally occurs for a few hours between VFR or MVFR weather. The weighted average methodology used in the Jacobs study tends to significantly overstate IFR delays and to understate VFR delays.
- The Jacobs study included a nighttime airspace departure noise abatement procedure between 10 pm and 7 am. This miles-in-trail restriction over the San Francisco Bay limits OAK and SFO departures and constrains originating flights at both airports during these hours. This restriction produces an early morning spike in the delays estimated in the Jacobs study.
- Each study used different aircraft fleet mixes. The Jacobs study focused on passenger flights and used an arbitrary daily mix of 700, 750 or 800 passenger jets plus 510 GA and cargo flights for VFR conditions; they assumed a reduction in the GA demand by 236 flights during IFR conditions. The RASP Update study used the actual 2007 OAK fleet mix, and scaled it up for future years according to the forecast.

[2] Jacobs Consultancy, *Ultimate Airfield Capacity Study*, August 19, 2009.

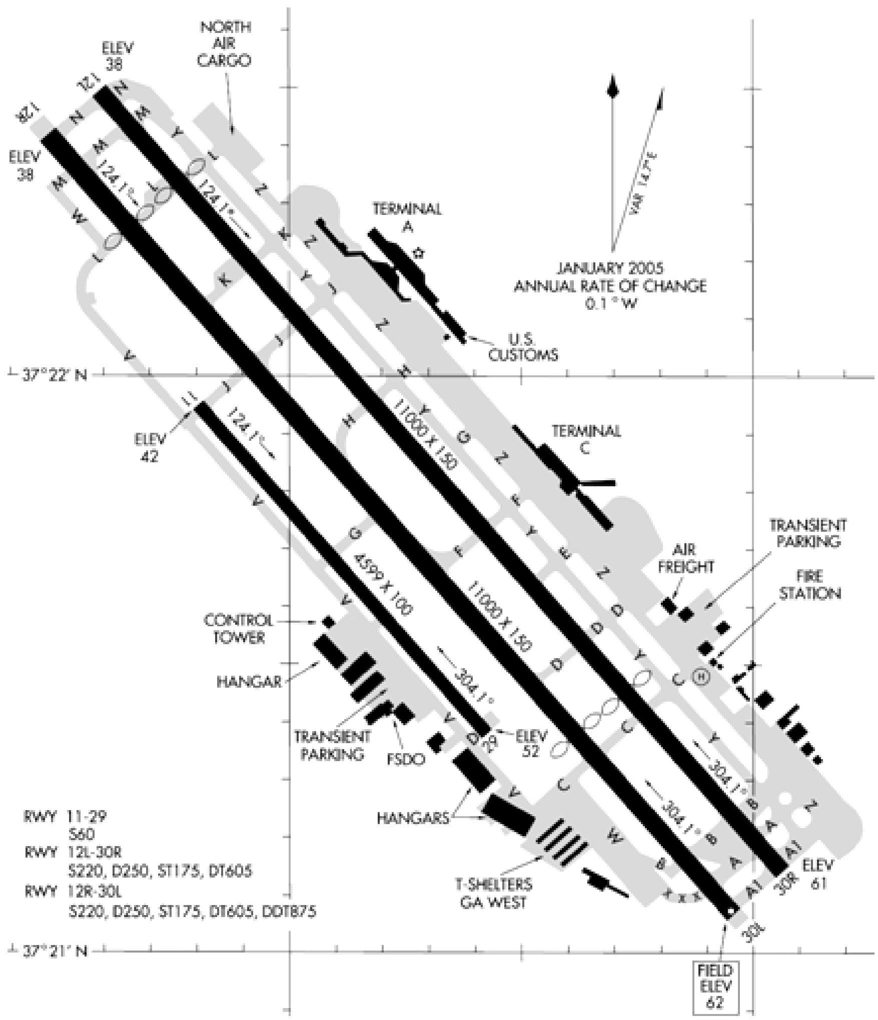
- The hourly profiles of flights for both studies are quite different. The Jacobs study produced an ADPM (average day of the peak month) profile for a hypothetical future flight schedule. This study used actual FAA radar data for 2007 to create average day profiles for weekdays, Saturdays and Sundays with monthly adjustments. The assumed number of flights per hour is a critical factor in the calculation of airfield delays.
- Although the SIMMOD model used in the Jacobs study calculates delays for all categories of traffic, the report presents the delays for passenger jets only, and ignores the GA and cargo delays. The RASP Update study calculates the average delay for all aircraft operations, including GA and cargo.
- The Jacobs study adopted an average delay of 7 minutes per passenger flight as the level of annual airfield capacity. This study used a range of 12-15 minutes of overall average delay for all flights.

4. NORMAN Y. MINETA SAN JOSE INTERNATIONAL AIRPORT (SJC)

4.1 Airport Configuration

San Jose International Airport is located at the southern end of the Bay Area and has the lowest base year and projected commercial traffic demand of the three major airports. The airport has three parallel runways: 12L-30R, 12R-30L and 11-29. Runway 11-29 on the south side of the airfield is 4,600 ft long and used primarily by general aviation. The other two runways are 11,000 ft long and serve commercial flights and most GA jets.

Exhibit 4-1: Layout of San Jose International Airport (SJC)



4.2 Runway Capacity

The FLAPS model was used to estimate the runway capacity of SJC under various operating conditions. The following sections discuss the modeling assumptions, the runway configurations modeled and the capacity results. The capacity analysis for SJC was based on the airfield layout, operating conditions and demand distribution for 2007. No further runway improvements are anticipated, but the airport is currently completing various terminal improvements on the north side of the runways, which are not depicted in Exhibit 4-1.

4.2.1 Fleet Mix Assumption

The aircraft operations and fleet mix for each analysis year are based on the actual and forecast activity presented in the *Baseline Aviation Activity Forecasts* report for SJC. Actual activity for 2007 and forecast activity for 2020 and 2035 include general aviation, air passenger and air cargo operations. For the capacity analysis, operations by aircraft type were summarized into nine aircraft classes, which distinguish operations by aircraft size and ramp area. (See Exhibit 4-2) The North ramp is where the air carrier terminals and cargo facilities are located. The South ramp is where general aviation aircraft are based, and is used mostly by GA, charter and military flights. Large jets, which have a maximum take-off weight between 41,000 and 255,000 pounds, are the dominant aircraft type and account for an increasing share of the fleet at SJC rising from 47 percent in the base year to 56 percent in 2035. Small propeller aircraft, which are projected to decline over the forecast period, account for 15 percent of activity in 2035 compared to 19 percent in 2007.

Exhibit 4-2: Summary of Base Year and Forecast Fleet Mixes for SJC

ID	Class	2007	2020	2035
SPS	Small props - South ramp	14.3%	12.1%	10.9%
SPN	Small props - North ramp	5.1%	4.3%	3.9%
SJ	Small jets	6.6%	6.2%	6.4%
LP	Large props	3.4%	2.7%	2.4%
LRJS	Large RJs & BJs - South ramp	8.9%	7.1%	8.2%
LRJN	Large RJs & BJs - North ramp	11.6%	9.3%	10.6%
LJ	Large jets	46.9%	50.1%	56.1%
5J	757s	1.8%	7.1%	0.4%
HJ	Heavy jets	1.5%	1.2%	1.1%

Notes: Small aircraft - ≤ 41,000 lbs
Large aircraft - >41,000 lbs and ≤ 255,000 lbs.
Heavy aircraft - > 255,000 lbs

Source:Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009.

4.2.2 Runway Configurations Modeled

Six configurations, consisting of combinations of runway and weather conditions, were modeled for SJC to represent operations under east and west flow for three weather conditions:

- VAPS – good VFR weather with ceilings at or above 4,500 ft and visibility at or above 5 nm.
- MVFR – marginal VFR weather below VAPS but with ceilings at or above 1,000 ft and visibility at or above 3 nm.

- IFR – IFR conditions with ceilings below 1,000 ft or visibility below 3 nm. For normal ILS operations, ceilings must be at or above 200 ft and visibility above 0.5 nm.

West Flow – VAPS

The active runways for the West Flow-VAPS configuration are Runway 29 and Runways 30L/30R. Runway 29 operates in mixed mode (both arrivals and departures). Runway 30L is used for arrivals and Runway 30R is used for departures.

Piston driven propellers from the south ramp are assigned to Runway 29 for arrival and takeoff. Piston driven propellers from the north ramp and turbo-props use Runways 29 or 30L for arrival and Runways 29 or 30R for takeoff. Small business jets are allowed to use Runways 29 or 30L for arrival but depart on Runway 30R. Large business jets and all commercial jets use Runway 30L for arrival and Runway 30R for takeoff. Reduced single-runway arrival-arrival, arrival-departure and departure-departure separations were applied to each runway to reflect the fact that the standard minimum separation standards under IFR conditions for successive operations can be reduced under good weather and good visibility conditions.

West Flow – MVFR

The runway assignments for the West Flow-MVFR configuration are the same as the runway assignments for the West Flow-VAPS configuration described above. The arrival-arrival separations for this configuration were increased to standard IFR values.

West Flow – IFR

Departure runway assignments for the West Flow-IFR configuration are the same as the runway assignments for West Flow-VAPS, but all arrivals use Runway 30L. Standard single-runway IFR separations were applied to each runway, and between Runways 29, 30L and 30R.

East Flow – VAPS

The active runways for the East Flow-VAPS configuration are Runway 11 and Runways 12L/12R. Runway 11 operates in mixed mode (both arrivals and departures). Runway 12R is used for arrivals and Runway 12L is used for departures.

Piston driven propeller aircraft from the south ramp are assigned to Runway 11 for arrival and takeoff. Piston driven propeller aircraft from the north ramp and turbo-props use Runway 11 or Runway 12R for arrival and Runway 11 or 1Runway 2L for takeoff. Small business jets are allowed to use Runway 11 or Runway 12R for arrival but depart on Runway 12L. Large business jets and all commercial jets use Runway 12R for arrival and Runway 12L for takeoff. Reduced single-runway arrival-arrival, arrival-departure and departure-departure separations were applied to each runway. Since pilots can see the other traffic around them in good weather conditions, the standard IFR separations can safely be reduced in this weather condition.

East Flow – MVFR

The runway assignments for East Flow-MVFR are the same as those for East Flow-VAPS described above. The arrival-arrival separations were increased to standard IFR values.

East Flow – IFR

For the East Flow-IFR configuration, departure runway assignments are the same as those for East Flow-VAPS, but all arrivals use Runway 12R. Standard single-runway IFR separations were applied to each runway, and between Runways 11, 12R and 12L.

4.2.3 Results

The results of the capacity analysis for SJC are shown below in Exhibit 4-3 for each of the analysis years. The values presented in the *Arrive, Depart and Saturation* columns are the maximum hourly throughput or saturation capacities for the airfield under balanced flow (i.e. equal numbers of departures and arrivals). The *Operational* column is 90 percent of the saturation capacity, based on the FAA's former method of estimating their Engineered Performance Standards for an airport. Generally, an airport's acceptance rate will lie between the theoretical Operational and Saturation capacities. For comparison, the current maximum arrival and departure acceptance rates at SJC, based on information provided by the FAA NorCal TRACON, are shown in the final two columns

Exhibit 4-3: Estimated Base Year and Forecast Runway Capacities for SJC

Year	Flow	Weather	Arrive 29	Arrive 30L	Depart 29	Depart 30R	Capacity Saturation	Capacity Operational	NorCal Arr	NorCal Dep
2007	West	VAPS	21	31	11	40	103	93	50	40
2007	West	MVFR	11	23	7	28	69	62	40	30
2007	West	IFR		30	6	24	60	54	25	25
			11	12R	11	12L	Saturation	Operational	Arr	Dep
2007	East	VAPS	21	29	10	39	99	89.1	50	40
2007	East	MVFR	12	23	7	28	70	63	40	30
2007	East	IFR		30	6	24	60	54	25	25
			29	30L	29	30R	Saturation	Operational	Arr	Dep
2020	West	VAPS	22	32	12	42	108	97	50	40
2020	West	MVFR	10	25	6	29	70	63	40	30
2020	West	IFR		32	5	27	64	58	25	25
			11	12R	11	12L	Saturation	Operational	Arr	Dep
2020	East	VAPS	22	32	13	41	108	97	50	40
2020	East	MVFR	10	25	6	29	70	63	40	30
2020	East	IFR		33	5	27	65	59	25	25
			29	30L	29	30R	Saturation	Operational	Arr	Dep
2035	West	VAPS	22	33	11	44	110	99	50	40
2035	West	MVFR	10	26	5	31	72	65	40	30
2035	West	IFR		33	5	28	66	59	25	25
			11	12R	11	12L	Saturation	Operational	Arr	Dep
2035	East	VAPS	23	33	12	44	112	101	50	40
2035	East	MVFR	10	26	5	31	72	65	40	30
2035	East	IFR		33	5	28	66	59	25	25

4.3 Runway Delays

The DELAYSIM model was used to estimate runway delays at SJC. In addition to the hourly capacities presented in the previous section, DELAYSIM also requires information on hourly weather observations, an hourly aircraft demand profile and the airport's wind rule.

4.3.1 Weather Assumptions

The delay modeling was based on hourly weather data for the 10-year period, 1998 to 2007. The hourly weather observations at SJC were obtained from the National Weather Service and included the following parameters which served as inputs to DELAYSIM:

- Date and time
- Wind speed and direction

- Ceiling
- Visibility
- Precipitation

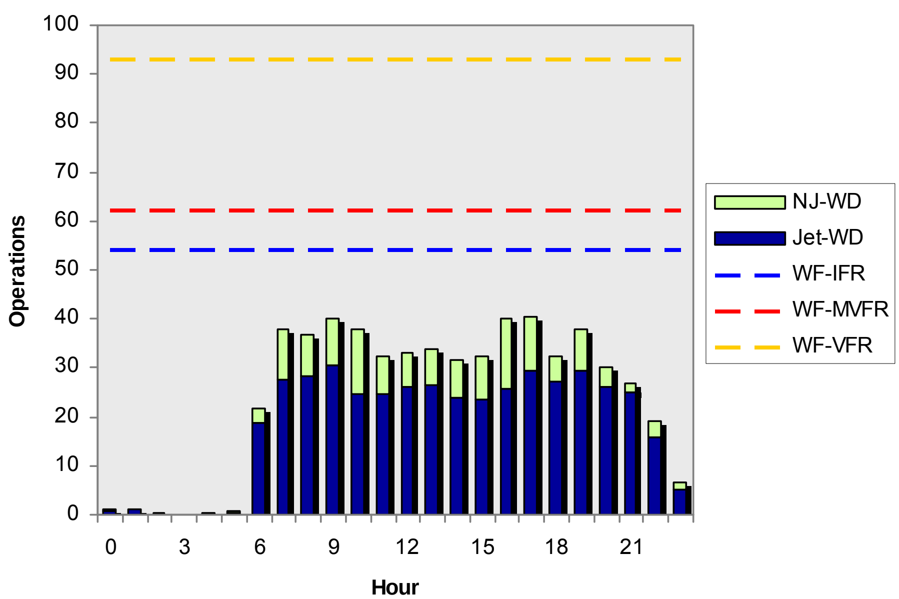
The weather data were processed to estimate missing values of some parameters, and to adjust the reported precipitation to the prior hour when it actually occurred. When more than one observation was reported in an hour, the average (wind speed and direction) or minimum (ceiling and visibility) was selected. In a few cases, where no observation was recorded, those hours were not modeled.

4.3.2 Hourly Demand Assumptions

The hourly distribution of aircraft demand is a key variable in estimating airfield delays. Radar tracking data for 2007 was used to estimate the hourly aircraft demand profiles for the base year. Separate profiles were developed for jets and non-jets, each for the average weekday, Saturday and Sunday. In addition, a monthly profile was developed to adjust the average profiles throughout the year. It should be noted that these profiles represent the total demand, including both arrivals and departures.

Exhibit 4-4 compares the jet and non-jet profiles for an average weekday in 2007. Exhibit 4-5 compares the total (jet plus non-jet) 2007 profiles for the average weekday, Saturday and Sunday. Exhibit 4-6 presents the variation in average demand by month of the year.

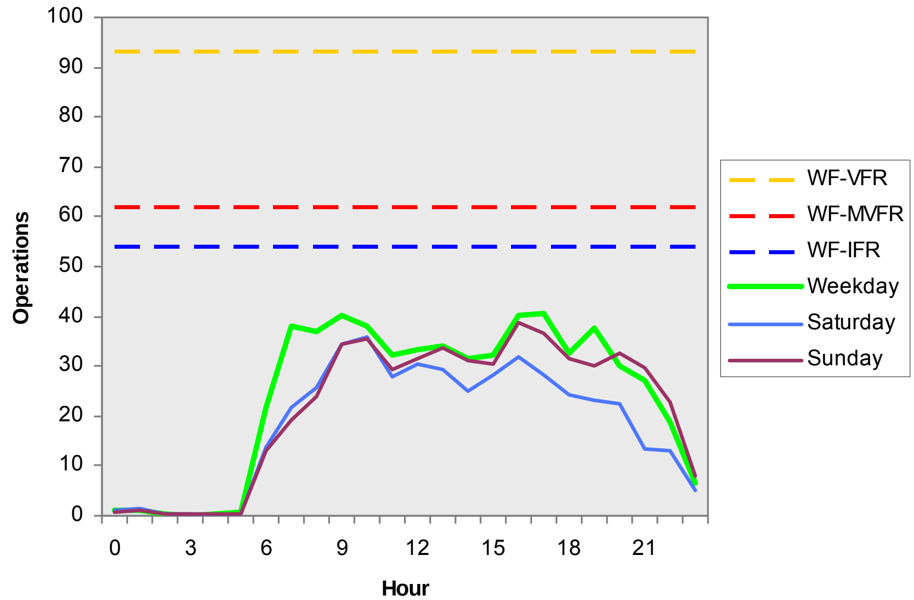
Exhibit 4-4: Jet and Non-Jet Operations per Hour at SJC, 2007 Average Weekday



Note: NJ-WD – non-jet weekday
Jet-WD – jet weekday

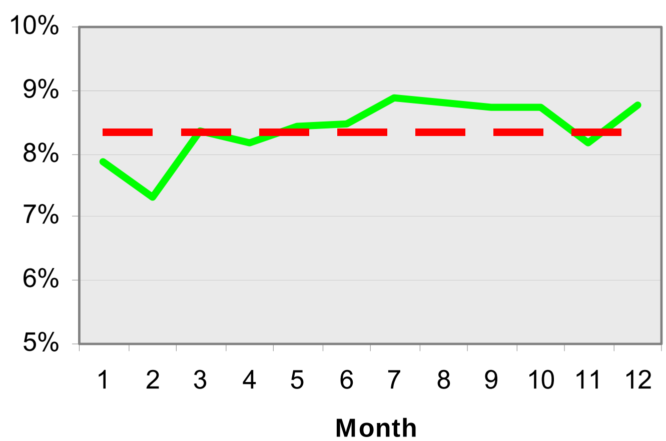
Source: Radar data.

Exhibit 4-5: Total Operations per Hour at SJC, 2007 Average Weekday, Saturday and Sunday



Source: Radar data.

Exhibit 4-6: Monthly Variation in Average Demand at SJC, 2007

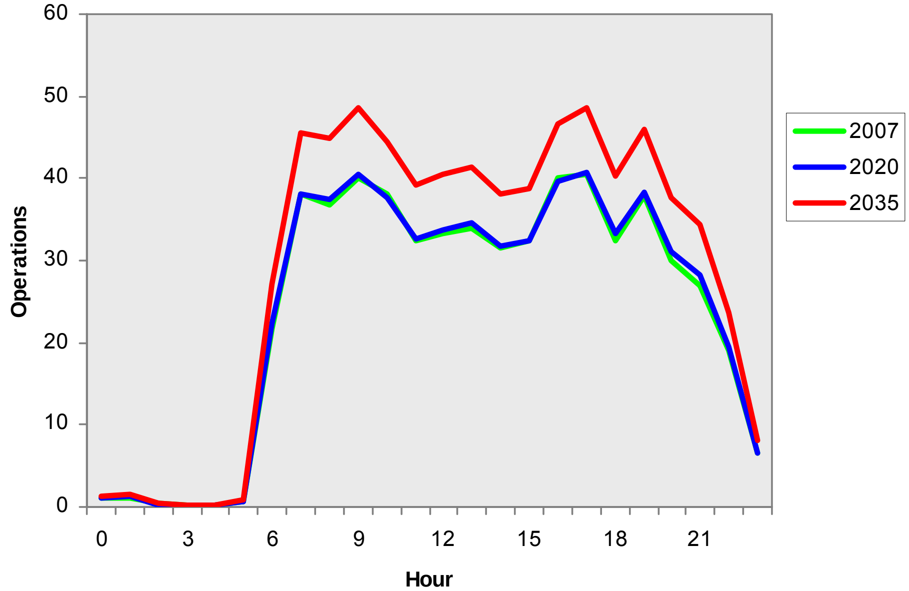


Source: Radar data.

The 2007 demand profiles for jet and non-jet aircraft operations were applied to forecast jet and non-jet operations for 2020 and 2035 to estimate future year demand profiles. Exhibit 4-7 compares the 2007 average weekday profile with those for 2020 and 2035. The 2020 profile is nearly the same as for 2007 due to the forecast decline in GA activity. Total demand in 2035 is higher than that in 2007.

Exhibit 4-7: Comparison of Average. Weekday Operations per Hour, Base Year 2007 vs. Forecast 2020 and 2035

Source: Radar data.



Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009.

4.3.3 Wind Rule Assumptions

The selection of available runways for each hour modeled depends on the weather conditions for that hour. The local wind rule specifies the maximum allowable crosswind and tailwind components in knots depending on whether the runway is dry or wet. Exhibit 4-8 summarizes the wind rule assumptions used for SJC.

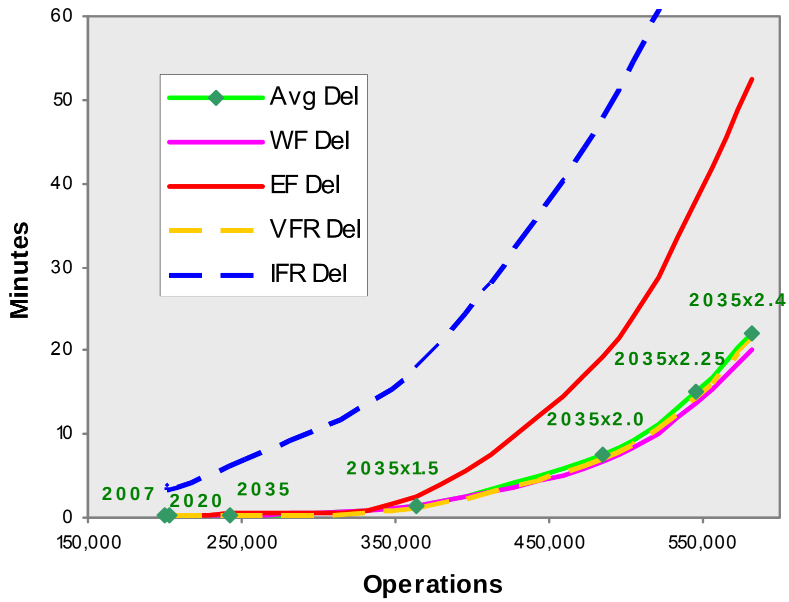
Exhibit 4-8: SJC - Maximum Allowable Crosswind and Tailwind Components, In Knots

	Dry	Wet
Crosswind	20	15
Tailwind	7	0

4.3.4 Estimated Average Aircraft Delays

DELAYSIM was run for the three analysis years: 2007, 2020 and 2035. The average aircraft delay for 2035 was less than a minute, so the 2035 demand was scaled up by 50 percent, 100 percent, 125 percent and 140 percent to estimate when delays at SJC may become congestive. Exhibit 4-9 presents the average aircraft delay for these scenarios. In addition to the average delay shown in green, the figure also shows the average delay for East and West flow and for VFR and IFR conditions. The average delay for West Flow is only slightly lower than the overall average since this is the predominant operating condition at SJC. However, the delays for IFR and for East Flow are considerably higher than the overall average.

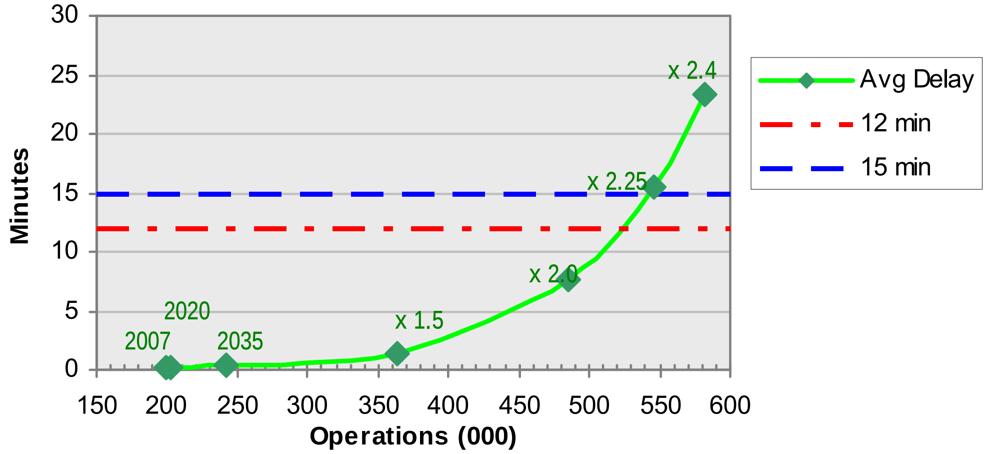
Exhibit 4-9: Base Year and Forecast Average Aircraft Delay at SJC



4.3.5 Estimated Airfield Capacity

Exhibit 4-10 depicts the average aircraft delay at SJC against the 12 and 15 minute average delay thresholds. As shown, the ultimate airfield capacity of SJC is approximately between 520,000 and 550,000 annual operations based on the forecast fleet mix. If a lower average aircraft delay of 8 minutes was used (similar to OAK), the airfield capacity would be approximately 485,000 annual operations. Using either delay value, SJC is not expected to experience runway capacity problems until well after 2035. In 2035, the average delay under all conditions is expected to be only about 1 minute per flight. Even during IFR conditions (less than 3% of the time), the average delay is projected to be less than 7 minutes in 2035 (see Exhibit 4-9). However, it should be noted that while SJC is forecast to have ample airfield capacity over the forecast period, the airport faces landside constraints that are likely to limit the airfield from reaching its full capacity.

Exhibit 4-10: Base Year and Forecast Aircraft Delays at SJC – Average Minutes of Delay vs. Annual Aircraft Operations

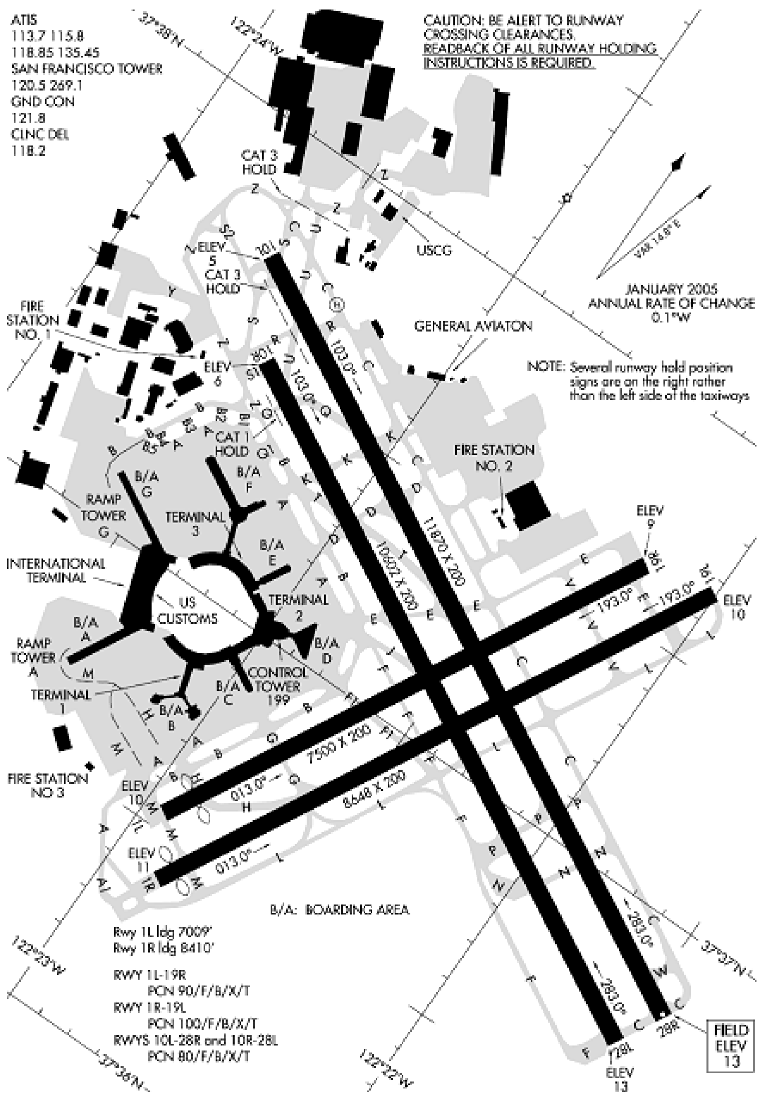


5. SAN FRANCISCO INTERNATIONAL AIRPORT (SFO)

5.1 Airport Configuration

San Francisco International Airport is the busiest commercial airport in the Bay Area. The airfield layout consists of two pairs of closely-spaced parallel runways: 10L-28L, 10R-28L, 01L-19R and 01R-19L. When weather conditions permit, the parallel runways are used together during periods of high demand to permit simultaneous pairs of arrivals and/or departures.

Exhibit 5-1: Layout of San Francisco International Airport



5.2 Runway Capacity

The FLAPS model was used to estimate the runway capacity of SFO under various operating conditions. The following sections discuss the modeling assumptions, runway configurations modeled and the capacity results. The capacity analysis of SFO was based on the existing airfield layout, operating conditions and demand distribution for 2007. Although San Francisco International Airport has studied additional potential runway configurations in the past, these are not considered in this study.

5.2.1 Fleet Mix Assumptions

Aircraft operations and fleet mix assumptions for the analysis years are based on the actual and forecast activity data presented in the *Baseline Aviation Activity Forecasts* report for SFO. Actual aircraft activity for 2007 and forecast aircraft activity for 2020 and 2035 include general aviation, air passenger and air cargo operations. For the capacity analysis SFO operations by aircraft type were summarized into nine aircraft classes, which distinguish operations by aircraft size and by runway length requirements for large, heavy and Boeing 757 jets. Large and heavy jets are forecast to account for an increasing share of SFO's aircraft operations. The large jet share increases from 55 percent in 2007 to 74 percent in 2035. Similarly, heavy jets grow from 15 percent of the SFO fleet in the base year to nearly 20 percent in 2035. (See Exhibit 5-2)

Exhibit 5-2: Summary of Base Year and Forecast Fleet Mixes for SFO

ID	Class	Runway Length Requirement	2007	2020	2035
SP	Small props		1.7%	0.9%	0.8%
SJ	Small jets		3.0%	2.2%	2.0%
LP	Large props		13.4%	5.5%	3.3%
LJS	Large jets	takeoff < 8600 ft	50.9%	61.4%	68.7%
LJL	Large jets	takeoff > 8600 ft	4.0%	4.8%	5.4%
5JS	757s	takeoff < 8600 ft	10.9%	7.9%	0.0%
5JL	757s	takeoff > 8600 ft	0.6%	0.5%	0.0%
HJS	Heavy jets	takeoff < 8600 ft	0.9%	1.0%	1.2%
HJL	Heavy jets	takeoff > 8600 ft	14.5%	15.7%	18.6%

Notes: Small aircraft - ≤ 41,000 lbs
Large aircraft - >41,000 lbs and ≤ 255,000 lbs.
Heavy aircraft - > 255,000 lbs

Source: Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009.

5.2.2 Configurations

Fourteen configurations, consisting of runway and weather condition combinations, were modeled for SFO to represent operations under east and west flow for three primary weather conditions:

- VAPS – good VFR weather with ceilings at or above 4,500 ft and visibility at or above 5 nm.
- MVFR – marginal VFR weather below VAPS but with ceilings at or above 1,000 ft and visibility at or above 3 nm.

- IFR – Instrument Flight Rule conditions with ceilings below 1,000 ft or visibility below 3 nm. For normal ILS operations, ceilings must be at or above 200 ft and visibility above 0.5 nm. For west flow, two additional IFR configurations were included: ILS Cat II (with a minimum ceiling of 100 ft and visibility of 0.33 nm) and ILS Cat III (with a minimum ceiling of zero ft and zero visibility).

West Flow – VAPS

The preferred configuration for SFO is to use Runways 28L/R for simultaneous pairs of arrivals, which are spaced side by side (commonly called wingtip operations). Most departures also are paired side-by-side on Runways 01L/R. Heavy and long-haul departures which need more than 8,600 feet of runway for takeoff use either Runway 28L or Runway 28R for departure. Standard minimum IFR separations were reduced for single-runway arrival-arrival, arrival-departure and departure-departure separations. Wake-vortex separations were applied between arrivals on Runways 28L/R and departures on Runways 01L/R.

West Flow – MVFR

The following configurations were analyzed for MVFR conditions.

Expanded Visuals – For this configuration, all arrivals are assigned to either Runway 28L or Runway 28R, but staggered separations are required on the two approaches. Departures which need less than 8,600 feet depart on Runway 01L or Runway 01R, and can be launched in pairs if crosswinds permit. Departures requiring more than 8,600 feet use Runways 28L/R. If crosswinds do not allow use of Runways 01L/R, all departures use Runways 28L/R between arrivals. The minimum weather conditions are a ceiling of 2,400 ft and visibility of 5 nm.

Simultaneous Offset Instrument Approaches (SOIA) – In this configuration, paired arrivals are sequenced on the ILS to Runway 28L and the Localizer Type Directional Aid (LDA) to Runway 28R. Paired departures requiring less than 8,600 feet for takeoff are launched from Runways 01L/R if wind permits; otherwise all departures use Runways 28L/R between arrivals. All departures requiring more than 8,600 feet use Runways 28L/R. The minimum weather conditions are currently a ceiling of 2,100 ft and visibility of 4 nm.

The arrival-arrival separations were increased to standard IFR values.

West Flow – IFR

Whenever weather conditions are lower than the SOIA requirements, SFO operates with standard ILS arrivals on runway 28R. If crosswinds allow, flights can depart on Runways 01L/R individually or in pairs. Otherwise, all departures take place on Runways 28L/R. Standard single-runway IFR separations were applied to each runway, and between Runways 01L/R and 28L/R. The ILS Cat II and ILS Cat III configurations were adapted from another study (for Boston Logan International Airport) which assumed reductions in the fleet mix and increases in arrival-arrival separations.

East Flow – VAPS

For the East Flow – VAPS configuration, all arriving flights occur on Runways 19L/R with staggered separations; departures use Runways 10L/R with wingtip separations. Standard IFR minimum separations were reduced for single-runway arrival-arrival, arrival-departure and departure-departure separations.

East Flow – MVFR

For the East Flow – MVFR configuration, all arrivals are to Runways 19L/R with staggered separations; departures use 10L/R with wingtip separations unless crosswinds prohibit, otherwise departures are assigned to Runways 19L/R. The arrival-arrival separations were increased to standard IFR values.

East Flow – IFR

In the East Flow – IFR configuration, all arrivals use Runway 19L. Departures are assigned to Runways 10L/R unless crosswinds are too strong. With strong crosswinds departures are interspersed with arrivals on Runways 19L/R. Standard IFR separations were imposed.

5.2.3 Results

The results of the capacity analysis are shown below in Exhibit 5-3 for each of the analysis years. The values presented in the *Arrive*, *Depart* and *Saturation* columns are the maximum hourly throughput or saturation capacities for the airfield under balanced flow (i.e., equal numbers of departures and arrivals). The *Operational* column is 90 percent of the saturation capacity, based on the FAA's former method of estimating their Engineered Performance Standards for an airport. Generally, an airport's acceptance rate will lie between the theoretical Operational and Saturation capacities. For comparison, the current maximum arrival and departure acceptance rates at SFO, based on information provided by FAA's NorCal TRACON, are shown in the final two columns

Exhibit 5-3: Estimated Base Year and Forecast Runway Capacities for SFO

			Arrive		Depart				Capacity		NorCal	
	Flow	Weather	28L	28R	01L	01R	28L	28R	Saturation	Operational	Arr	Dep
2007	West	VAPS	27	27	15	25	7	6	107	96	60	50
2007	West	SOIA	21	21	15	19	4	4	84	76	36	42
2007	West	SOIA	21	21			23	18	83	75	36	42
2007	West	MVFR	25	23	13	23	7	6	97	87	45	48
2007	West	MVFR	19	26			30	16	91	82	45	40
2007	West	IFR		31	10	15	6		62	56	30	42
2007	West	IFR		31			24	7	62	56	30	38
2007			19L	19R	10L	10R	19L	19R	Saturation	Operational	Arr	Dep
2007	East	VAPS	24	19	25	18			86	77	40	40
2007	East	MVFR	15	16	19	12			62	56	27	40
2007	East	MVFR	20	10			12	17	59	53	25	35
2007	East	IFR	30		26	4			60	54	27	40
2007	East	IFR	29				3	25	57	51	25	33
2020			28L	28R	01L	01R	28L	28R	Saturation	Operational	Arr	Dep
2020	West	VAPS	28	27	15	25	9	6	110	99	60	50
2020	West	SOIA	22	22	15	19	5	5	88	79	36	42
2020	West	SOIA	22	22			24	20	88	79	36	42
2020	West	MVFR	25	25	12	22	8	8	100	90	45	48
2020	West	MVFR	18	26			29	15	88	79	45	40
2020	West	IFR		34	9	17	8		68	61	30	42
2020	West	IFR		34			29	5	68	61	30	38
2020			19L	19R	10L	10R	19L	19R	Saturation	Operational	Arr	Dep
2020	East	VAPS	23	20	27	16			86	77	40	40
2020	East	MVFR	16	15	21	10			62	56	27	40
2020	East	MVFR	19	11			14	16.7	61	55	25	35
2020	East	IFR	29		26	4			59	53	27	40
2020	East	IFR	29				4	25.1	58	52	25	33
2035			28L	28R	01L	01R	28L	28R	Saturation	Operational	Arr	Dep
2035	West	VAPS	28	28	14	25	10	6	111	100	60	50
2035	West	SOIA	23	22	15	19	6	6	91	82	36	42
2035	West	SOIA	23	22			24	21	90	81	36	42
2035	West	MVFR	26	26	11	22	10	9	104	94	45	48
2035	West	MVFR	19	27			30	16	92	83	45	40
2035	West	IFR		34	8	16	10		68	61	30	42
2035	West	IFR		34			28	6	68	61	30	38
2035			19L	19R	10L	10R	19L	19R	Saturation	Operational	Arr	Dep
2035	East	VAPS	25	18	31	13			87	78	40	40
2035	East	MVFR	15	16	19	12			62	56	27	40
2035	East	MVFR	19	11			14	15.9	60	54	25	35
2035	East	IFR	29		25	4			58	52	27	40
2035	East	IFR	29				4	26	59	53	25	33

5.3 Runway Delays

Runway delays were estimated using the DELAYSIM model as described in Section 2. In addition to the hourly capacity inputs presented above, DELAYSIM also requires information on hourly weather observations, an hourly aircraft demand profile and the airport's wind rule, which are described below.

5.3.1 Weather Assumptions

Ten years of hourly weather observations at SFO for the period 1998 through 2007 were used in the DELAYSIM model.

The weather data were obtained from the National Weather Service and included the following parameters as inputs to the delay model:

- Date and time
- Wind speed and direction
- Ceiling
- Visibility
- Precipitation

The weather data were processed to estimate missing values of some parameters, and to adjust the reported precipitation to the prior hour when it actually occurred. When more than one observation was reported in an hour, the average (wind speed and direction) or minimum (ceiling and visibility) was selected. In a few cases, where no observation was recorded, those hours were not modeled.

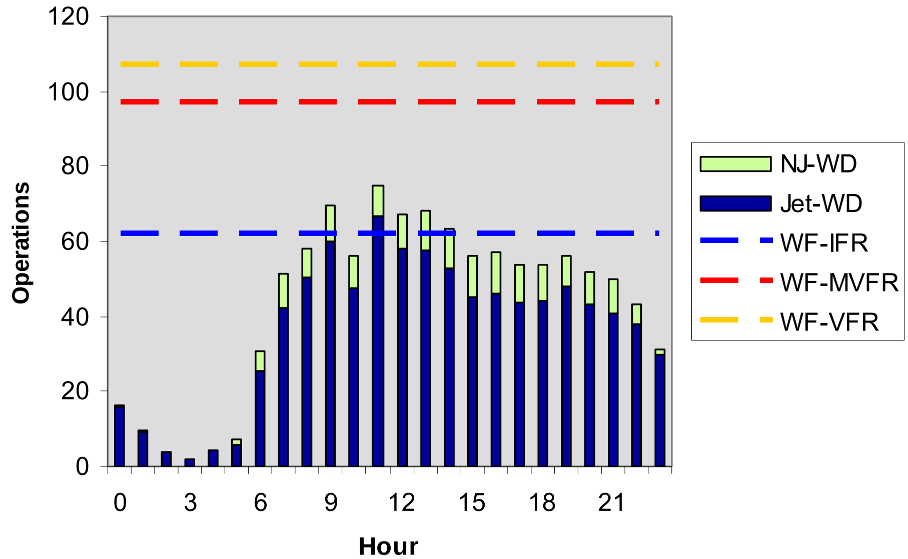
The resulting file, with date and time in GMT, was then input into the DELAYSIM model.

5.3.2 Hourly Demand Assumptions

A key variable in estimating airfield delays is the number and type of aircraft that need to arrive or depart during each hour. Radar tracking data for 2007 was used to estimate the hourly aircraft demand profiles for the base year. Separate profiles were developed for jets and non-jets, each for the average weekday, Saturday and Sunday. In addition, a monthly profile was developed to adjust the average profiles throughout the year. It should be noted that these profiles represent the total demand, including both arrivals and departures.

Exhibit 5-4 compares the jet and non-jet profiles for an average weekday in 2007. Exhibit 5-5 compares the total (jet plus non-jet) 2007 profiles for the average weekday, Saturday and Sunday and compares these to the airport's typical capacity. Exhibit 5-6 presents the variation in average demand by month of the year.

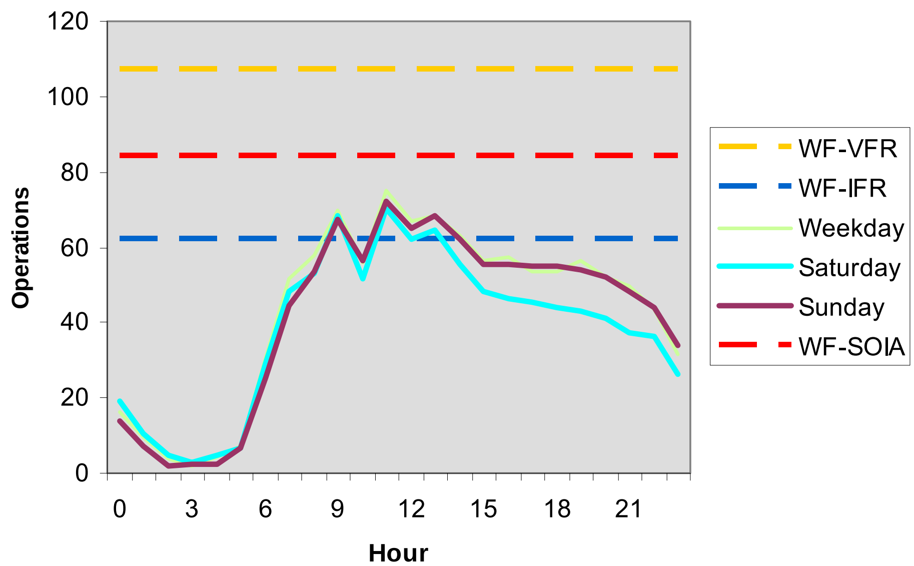
Exhibit 5-4: Jet and Non-Jet Operations per Hour at SFO, 2007 Average Weekday



Note: NJ-WD – non-jet weekday
Jet-WD – jet weekday

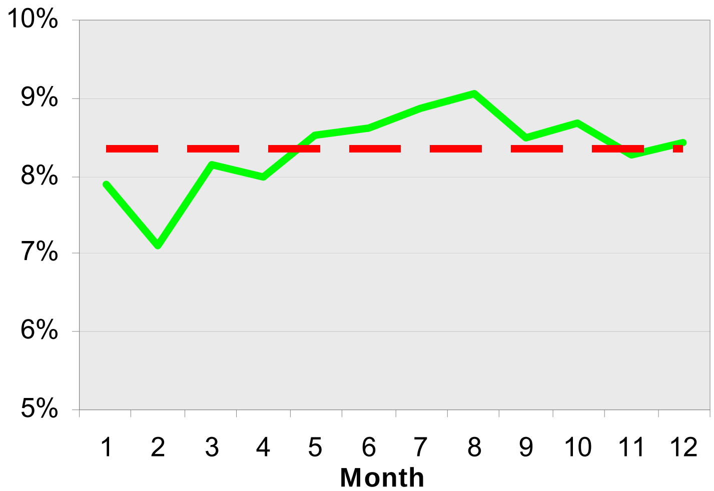
Source: Radar data.

Exhibit 5-5: Total Operations per Hour at SFO, 2007 Average Weekday, Saturday and Sunday



Source: Radar data.

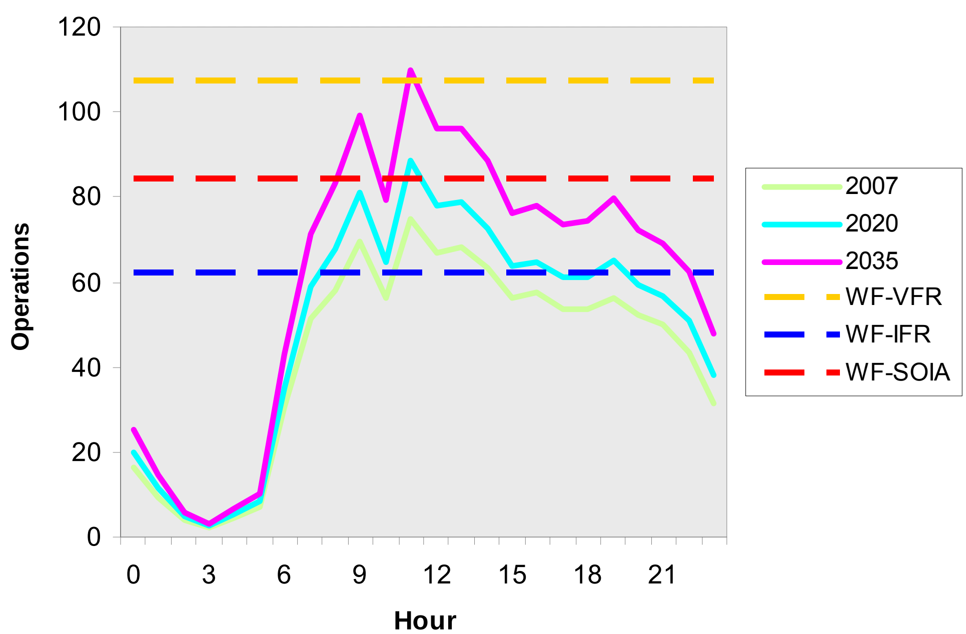
Exhibit 5-6: Monthly Variation in Average Demand at SFO, 2007



Source: Radar data.

The jet and non-jet demand profiles for 2007 were applied to the forecasts of jet and non-jet operations for 2020 and 2035 to estimate future year demand profiles. Exhibit 5-7 compares the 2007 average weekday profile with those for 2020 and 2035.

Exhibit 5-7: Comparison of Average Weekday Operations per Hour, Base Year 2007 vs. Forecast 2020 and 2035



Note: Capacities are for 2035.

Source: Radar data.

5.3.3 Wind Rule Assumptions

The selection of available runways each hour depends on the weather conditions. The local wind rule, summarized in Exhibit 5-8, specifies the maximum allowable crosswind and tailwind components in knots depending on whether the runway is dry or wet.

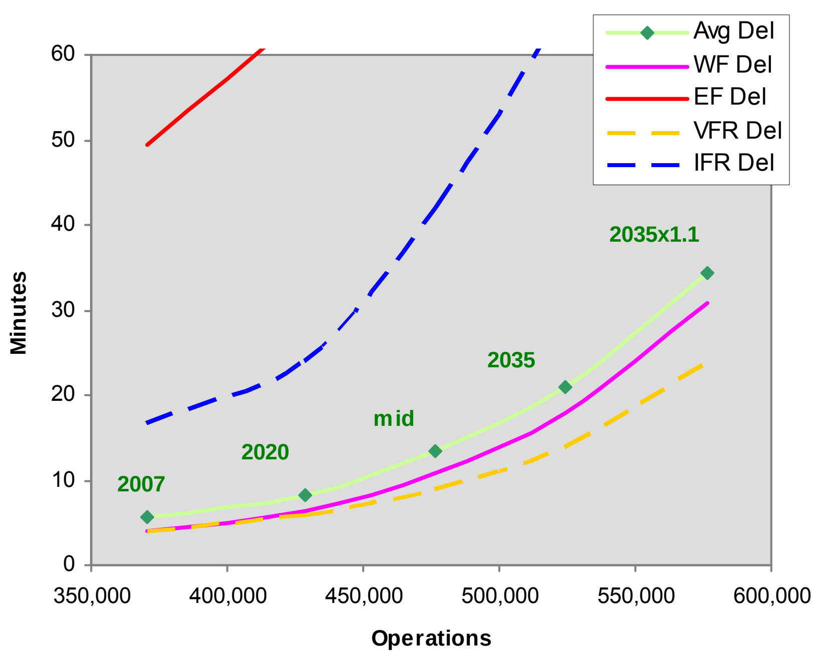
Exhibit 5-8: SFO - Maximum Allowable Crosswind and Tailwind Components, In Knots

	Dry	Wet
Crosswind	20	15
Tailwind	7	0

5.3.4 Estimated Average Aircraft Delays

DELAYSIM was run for the three analysis years: 2007, 2020 and 2035. Exhibit 5-9 shows the average aircraft delay in green, and also shows the average delay for East and West flow and for VFR and IFR conditions. Average delays at SFO is projected to increase from 5.7 minutes in the base year to 8.4 minutes in 2020 and 21.0 minutes in 2035.The average delay for West Flow is only slightly lower than the overall average since this is the predominant operating condition. However, the delays for IFR and for East Flow are considerably higher than the overall average.

Exhibit 5-9: Base Year and Forecast Average Aircraft Delay at SFO

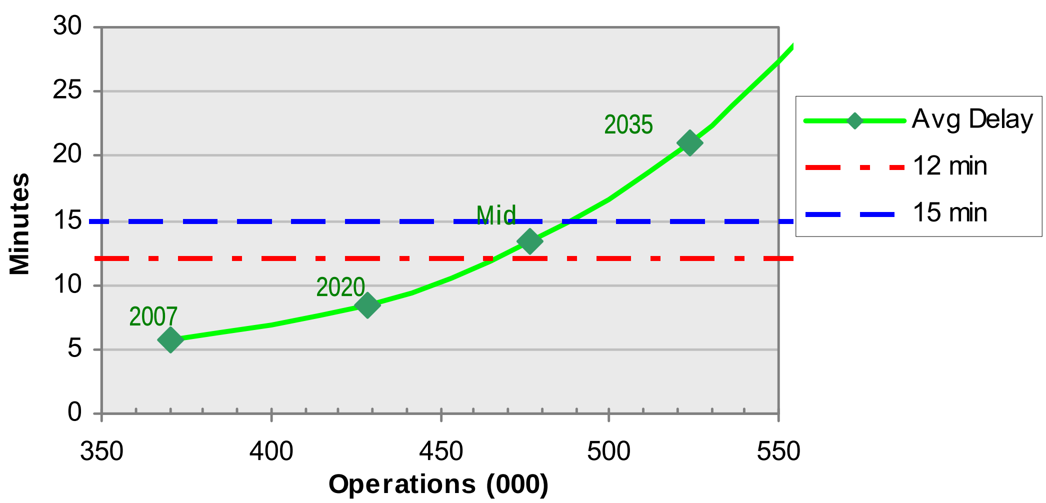


5.3.5 Estimated Airfield Capacity

Exhibit 5-10 presents the average aircraft delay at SFO against the average delay thresholds of 12 and 15 minutes. The ultimate capacity of SFO is approximately 460,000 to 485,000 annual operations, based on the forecast fleet mix and the 12 to 15 minute delay threshold. Using this delay threshold, SFO is projected to exceed its airfield capacity and reach unacceptable levels of congestion some time after 2020 and before 2035. SFO officials believe a lower threshold may be appropriate for assessing the airport's capacity since arrival delays are significantly greater than departure delays.

The major airfield capacity issues at SFO are the variability of weather conditions and the forecast growth of traffic through 2035. When the airport is operating in West Flow under good VFR conditions (56% of the time), the ability to conduct simultaneous paired arrivals keeps the average delay under 2 minutes through 2020. But with the forecast traffic growth, this will increase to over 10 minutes by 2035. The problems occur when stratus clouds over the Bay or unfavorable winds preclude the use of paired approaches. Even with the use of paired arrivals under Simultaneous Offset Instrument Approaches (SOIA), runway capacity is reduced by about 20% and the average delays approach unacceptable levels today. When weather conditions are IFR (about 16% of the time) or when winds require the use of Southeast Flow (between 3% and 4% of the time), the delays escalate enormously (see exhibit 5-9). The average delay for all conditions is projected to be about 21 minutes in 2035, but Advanced ATC Concepts hold promise to reduce this significantly.

Exhibit 5-10: Base Year and Forecast Aircraft Delays at SFO – Average Minutes of Delay vs. Annual Aircraft Operations



APPENDIX
BASELINE CAPACITY AND DELAY REPORT

Base Case Forecast Aircraft Operations at Primary Bay Area Airports

Category	Oakland 2007	Oakland 2020	Oakland 2035	San Francisco 2007	San Francisco 2020	San Francisco 2035	San Jose 2007	San Jose 2020	San Jose 2035
Air Carrier Passenger	155,900	161,100	192,600	326,200	384,600	461,200	127,800	129,500	153,000
All-Cargo	32,200	34,300	40,500	9,800	12,000	19,000	3,000	3,200	3,700
Subtotal Air Carrier	188,100	195,400	233,100	336,000	396,600	480,200	130,800	132,700	156,700
GA - Jets	18,600	23,300	33,200	27,800	27,600	39,300	28,600	31,100	44,300
GA - Nonjets	48,900	35,900	38,700	6,400	4,300	4,500	24,600	23,100	24,900
Total GA (Itinerant)	67,500	59,200	71,900	34,200	31,900	43,800	53,200	54,200	69,200
Subtotal Above	**255,600**	**254,600**	**305,000**	**370,200**	**428,500**	**524,000**	**184,000**	**186,900**	**225,900**
Military (total)	400	400	400	2,700	2,700	2,700	100	100	100
GA - Local Ops	81,300	46,000	49,600	100	-	-	15,700	15,500	16,700
Subtotal Local & Military	81,700	46,400	50,000	2,800	2,700	2,700	15,800	15,600	16,800
Total All Operations	**337,300**	**301,000**	**355,000**	**373,000**	**431,200**	**526,700**	**199,800**	**202,500**	**242,700**

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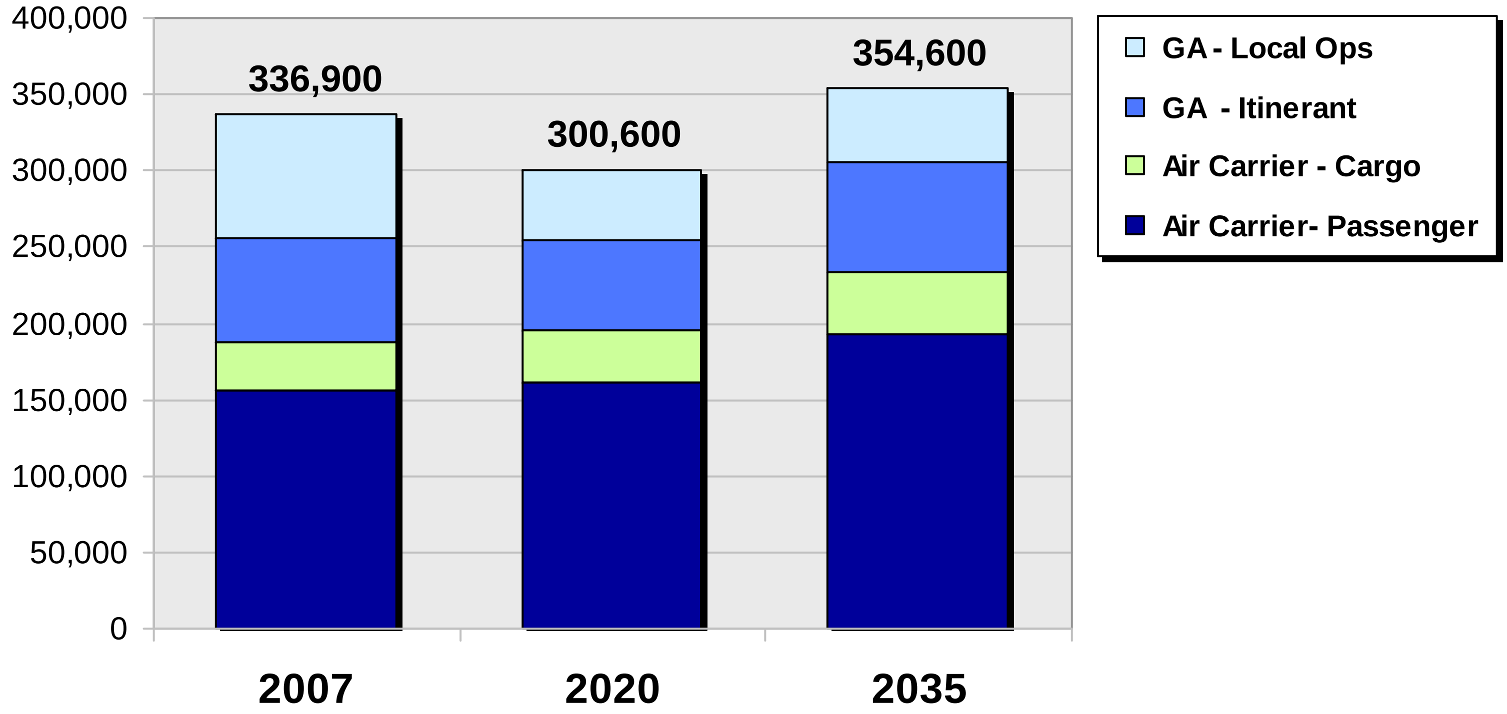
OAK's Runway Demand is Forecast to Decline from 2007 to 2020, then Resume Growth, Increasing to 355,000 Operations in 2035

Annual Aircraft Operations

Baseline 2007 and Base Case Forecast 2020 and 2035



Note: Includes runway demand for both the North and South Fields. Excludes military operations.

Source: Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009

Large and Heavy Weight Aircraft are Forecast to Account for an Increasing Share of OAK's Aircraft Demand

Annual Operations by Aircraft Weight Class and Type

Baseline 2007 and Base Case Forecast 2020 and 2035

Weight Class	Type	Percent of Annual Operations 2007	2020	2035
Small	Jet	3.0%	3.9%	4.2%
	Non-Jet	40.1%	28.9%	26.6%
	Subtotal	**43.1%**	**32.8%**	**30.8%**
Large	Turboprop	1.9%	2.4%	2.3%
	Jet	43.1%	49.3%	51.5%
	Regional Jet	6.0%	7.0%	8.3%
	Subtotal	**51.0%**	**58.7%**	**62.0%**
Boeing 757	**Jet**	**0.8%**	**1.7%**	**0.3%**
Heavy	**Jet**	**5.1%**	**6.9%**	**6.9%**
Total		100.0%	100.0%	100.0%

Notes: Small = <44,000 lbs; Large = >44,000 lbs and < 300,000 lbs; Heavy = > 300,000 lbs

Excludes military operations.

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Source: Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009

OAK's Maximum Capacity Configuration Can Accommodate Over 70% of Operations

Modeled Capacities of Runway Configurations

Baseline 2007 and Base Case Forecast 2020 and 2035

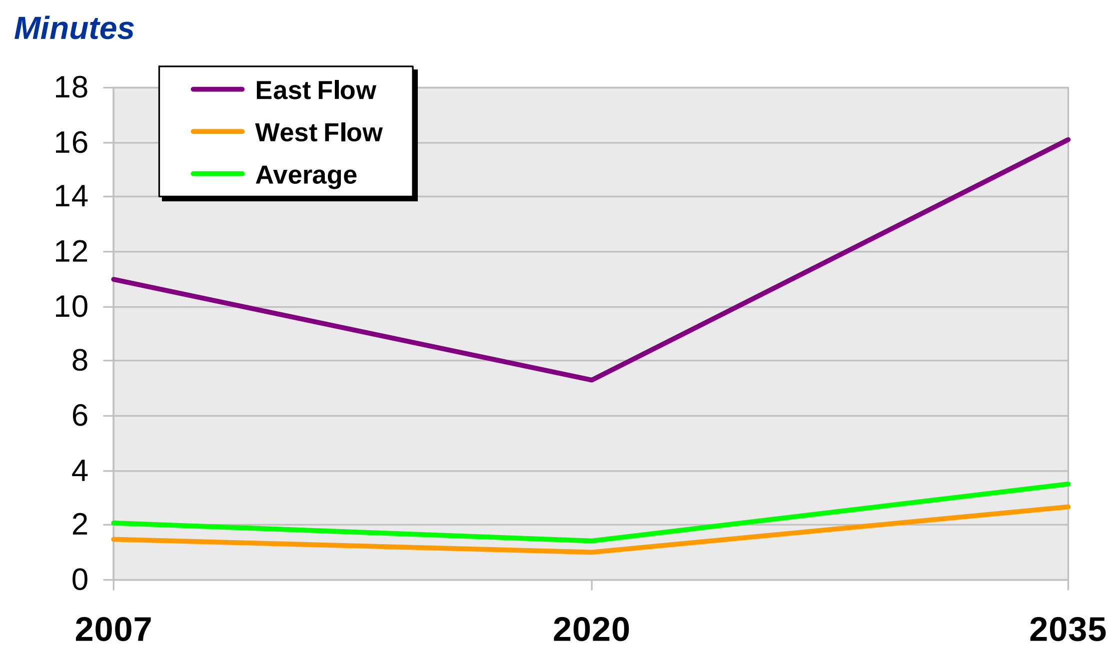
				Runways				Capacity (ops/hr)		
Percent of 2007 Ops	Configuration ID	Flow	Weather	Jet Landings	Non-Jet Landings	Jet Take-offs	Non-jet Take-offs	2007	2020	2035
72.0%	D-01-VAPS-01	West	VFR	27L 27R 29	27L 27R 29	29	27L 27R 29	105	88	85
16.2%	D-01-IFR-01	West	IFR	27R 29	27R 29	29	27L	55	54	54
5.6%	D-01-MVFR-03	West	MVFR	27L 27R 29	27L 27R 29	29	27L 27R 29	67	61	59
2.4%	D-02-VAPS-03	East	VFR	11	09L 09R 11	09L 09R 11	09L 09R 11	76	71	70
2.0%	D-02-MVFR-02	East	MVFR	11	11	09L 09R 11	09L 09R 11	56	52	51
1.4%	D-02-IFR-03	East	IFR	11	11	09R 11	09R 11	44	43	45
0.2%	D-01-IFR-04	West	IFR	29	29	29	29	39	39	39
0.1%	D-01-IFR-03	West	IFR	29	29	29	29	44	44	44

Average Delay at OAK is Estimated at Less than 4 minutes Over the Forecast Period, but East Flow Delays Reach 16 Minutes in 2035

- **OAK operates to the West 93% of the time**
- **East flow capacity under IFR is reduced due to the displaced ILS hold point for departures on Runway 11**
- **GPS approaches in East flow exist to the North Field but conflict with the ILS to the South Field**

Average Minutes of Delays by Major Operating Conditions

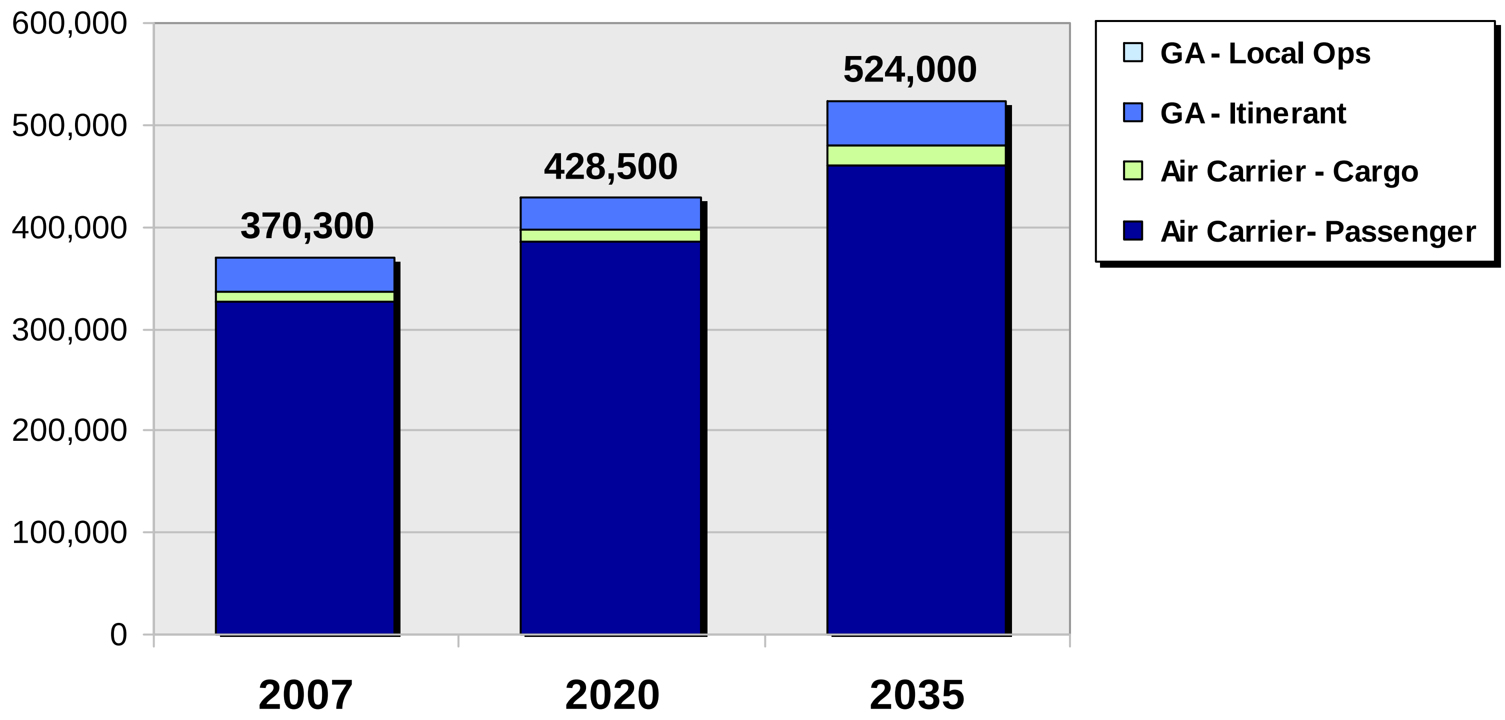
Baseline 2007 and Forecast 2020 and 2035



Runway Demand at SFO is Projected to Increase by 42% Over the Forecast Period

Annual Aircraft Operations

Baseline 2007 and Base Case Forecast 2020 and 2035



Note: Excludes military operations.

Source: Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009

The Future Fleet Mix at SFO Reflects Its Role as an International Gateway, with Large and Heavy Jets Accounting for an Increasing Share of Aircraft Operations

Annual Operations by Aircraft Weight Class and Type

Baseline 2007 and Base Case Forecast 2020 and 2035

Weight Class	Type	Percent of Annual Operations 2007	2020	2035
Small	Jet	3.0%	2.3%	2.2%
	Non-Jet	1.7%	1.0%	0.8%
	Subtotal	**4.8%**	**3.2%**	**3.1%**
Large	Turboprop	13.4%	7.9%	3.8%
	Jet	38.2%	46.3%	57.5%
	Regional Jet	16.7%	14.3%	13.2%
	Subtotal	**68.2%**	**68.4%**	**74.5%**
Boeing 757	**Jet**	**11.6%**	**9.4%**	**0.0%**
Heavy	**Jet**	**15.4%**	**18.9%**	**22.4%**
Total		100.0%	100.0%	100.0%

Notes: Small = <44,000 lbs; Large = >44,000 lbs and < 300,000 lbs; Heavy = > 300,000 lbs

Excludes military operations.

Source: Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009

When Operating in West Flow VFR Conditions, SFO Can Accommodate up to 100 Operations per Hour

Modeled Capacities of Runway Configurations

Baseline 2007 and Base Case Forecast 2020 and 2035

				Runways				Capacity (ops/hr)		
Percent of 2007 Ops	Configuration ID	Flow	Weather	Jet Landings	Non-Jet Landings	Jet Take-offs	Non-jet Take-offs	2007	2020	2035
58.1%	D-01-VAPS-01	West	VFR	28L 28R	28L 28R	01L 01R	01L 01R	95	99	100
20.7%	D-01-MVFR-02	West	MVFR	28R	28R	28L	28L	81	81	83
9.8%	D-01-IFR-02	West	IFR	28R	28R	28L	28L	56	61	61
3.1%	D-01-MVFR-01	West	MVFR	28L 28R	28L 28R	01L 01R 28L 28R	01L 01R	87	90	93
2.8%	D-01-IFR-01	West	IFR	28R	28R	01L 01R 28L	01L 01R	56	62	62
1.7%	D-02-VFR-01	East	VFR	19L 19R	19L 19R	10L 10R	10L 10R	77	77	77
1.4%	D-01-SOIA-01	West	MVFR	28L 28R	28L 28R	01L 01R 28L 28R	01L 01R	75	81	81
1.1%	D-02-MVFR-02	East	MVFR	19L 19R	19L 19R	19L 19R	19L 19R	53	55	54
0.5%	D-01-SOIA-02	West	MVFR	28R	28R	28L	28L	75	80	81
0.4%	D-02-MVFR-01	East	MVFR	19L 19R	19L 19R	10L 10R	10L 10R	56	56	56
0.1%	D-01-IFR-04	West	IFR	28R	28R	28L	28L	40	40	40
0.1%	D-02-IFR-02	East	IFR	19L	19L	19L 19R	19L 19R	52	52	50
0.1%	D-01-IFR-03	West	IFR	28R	28R	28L	28L	45	45	45
0.1%	D-02-IFR-01	East	IFR	19L	19L	10L 10R	10L 10R	53	53	52

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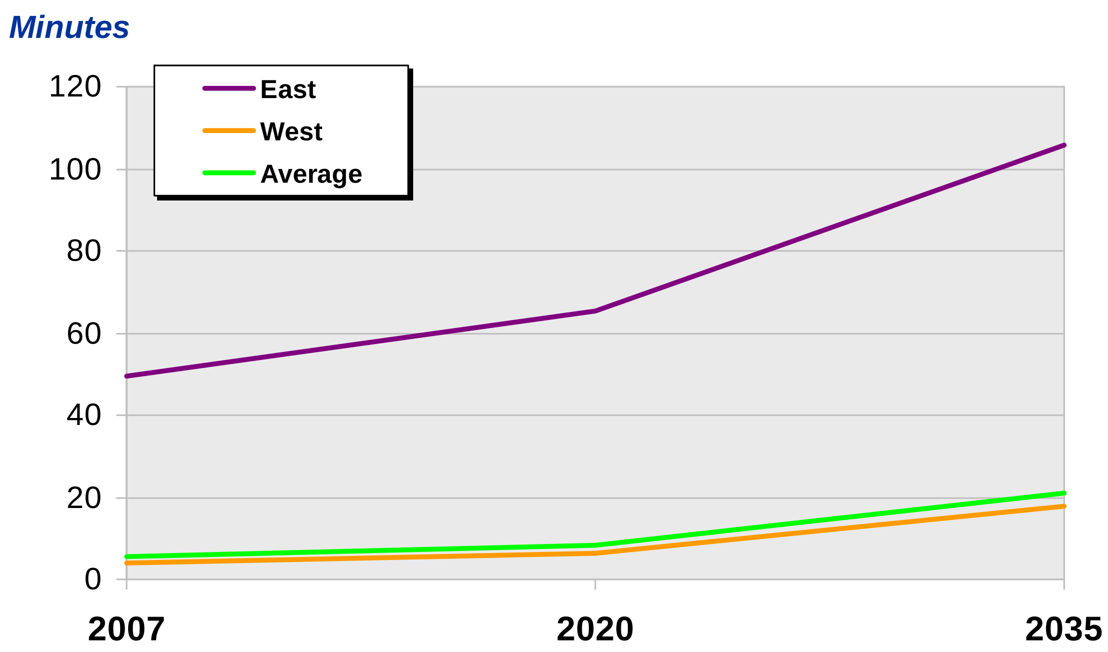
Note: The baseline capacity analysis does not assume any improvements to SOIA procedures.

In 2035, Average Delay at SFO Reaches 21 Minutes, and Average East Flow Delay Exceeds 100 Minutes

- **SFO operates to the West 93% of the time**
- **East flow VFR capacities are generally much lower than West flow**
- **East flow generally occurs during stormy winter weather**

Average Minutes of Delays by Major Operating Conditions

Baseline 2007 and Forecast 2020 and 2035

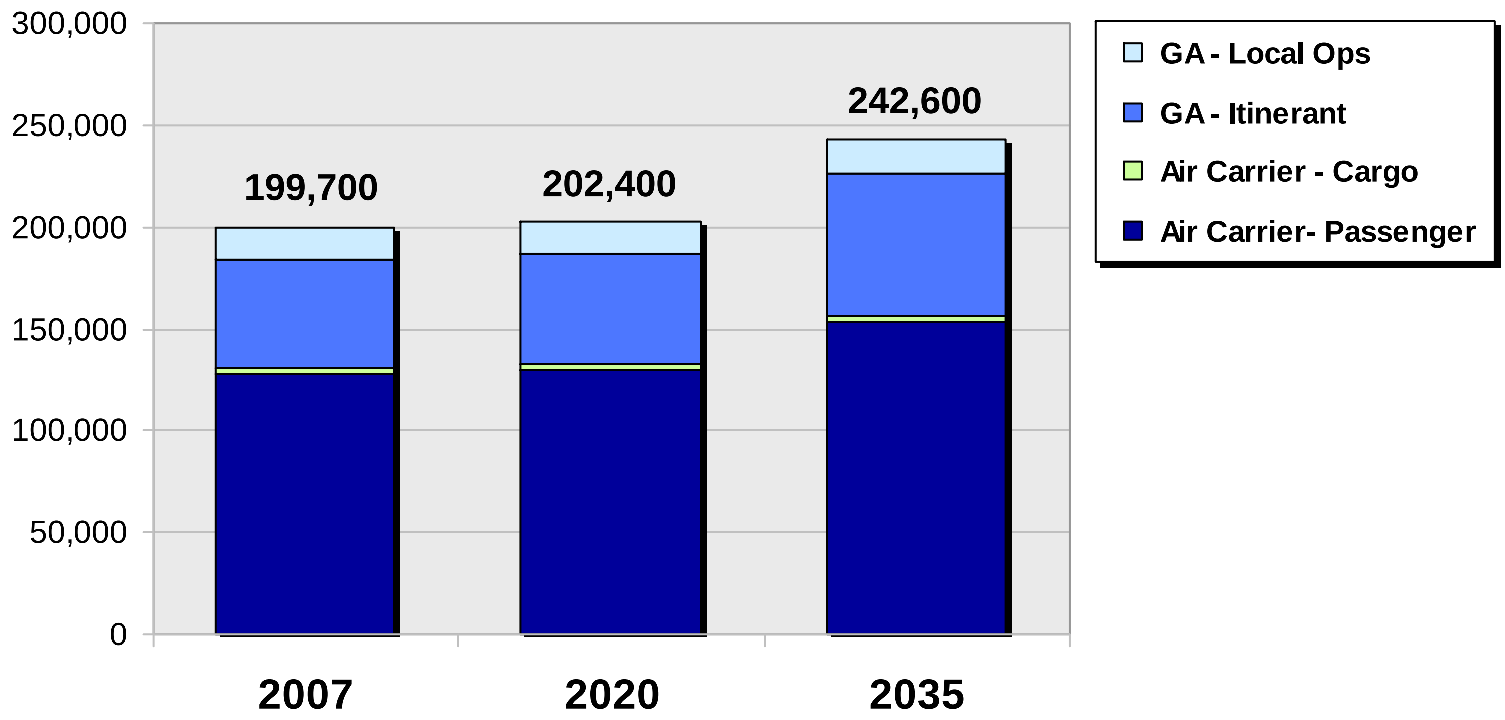


Note: 2007 capacities = 95 VFR and 56 IFR; 2020 capacities = 99 VFR and 61 IFR

SJC's Runway Demand is Forecast to Increase by 21% from 2007 to 2035

Annual Aircraft Operations

Baseline 2007 and Base Case Forecast 2020 and 2035



Note: Excludes military operations.

Source: Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009

Over the Forecast Period, Large Jets Become More Prevalent at SJC, Increasing from 47% to 56% of Aircraft Activity

Annual Operations by Aircraft Weight Class and Type

Baseline 2007 and Base Case Forecast 2020 and 2035

Weight Class	Type	Percent of Annual Operations 2007	2020	2035
Small	Jet	6.6%	6.1%	6.4%
	Non-Jet	19.3%	16.4%	14.7%
	Subtotal	**25.9%**	**22.5%**	**21.1%**
Large	Turboprop	3.4%	2.7%	2.4%
	Jet	46.9%	50.1%	56.1%
	Regional Jet	20.5%	16.4%	18.8%
	Subtotal	**70.8%**	**69.3%**	**77.4%**
Boeing 757	**Jet**	**1.8%**	**7.1%**	**0.4%**
Heavy	**Jet**	**1.5%**	**1.1%**	**1.1%**
Total		100.0%	100.0%	100.0%

Notes: Small = <44,000 lbs; Large = >44,000 lbs and < 300,000 lbs; Heavy = > 300,000 lbs

Excludes military operations.

Source: Regional Airport System Plan Update – Baseline Aviation Activity Forecasts for the Primary Bay Area Airports, August 27, 2009

At SJC More than 80% of Operations are Conducted Under Optimal Weather (VFR) Conditions

Modeled Capacities of Runway Configurations

Baseline 2007 and Base Case Forecast 2020 and 2035

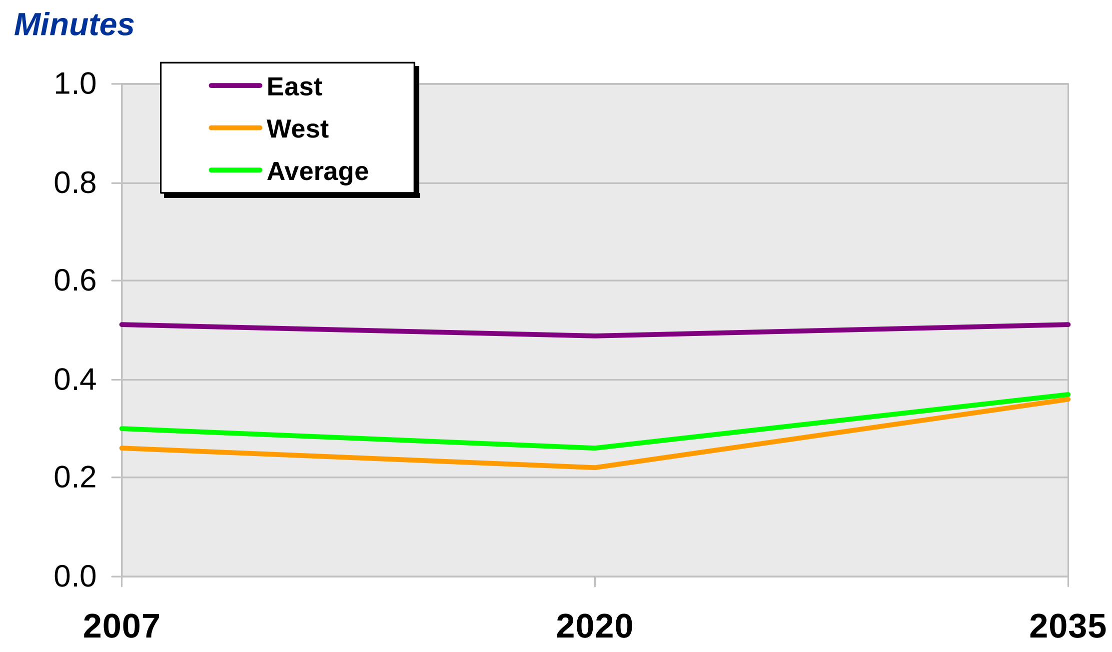
				Runways				Capacity (ops/hr)		
Percent of 2007 Ops	Configuration ID	Flow	Weather	Jet Landings	Non-Jet Landings	Jet Take-offs	Non-jet Take-offs	2007	2020	2035
80.8%	D-01-VAPS-01	West	VFR	29 30L	29 30L	30R	29 30R	92	98	103
12.0%	D-02-MVFR-01	East	MVFR	11 12R	11 12R	12L	11 12L	62	63	64
3.1%	D-02-VAPS-01	East	VFR	11 12R	11 12R	12L	11 12L	89	96	98
2.5%	D-01-MVFR-02	West	MVFR	29 30L	29 30L	30R	29 30R	62	63	65
1.3%	D-01-IFR-01	West	IFR	30L	30L	30R	29 30R	54	59	59
0.2%	D-02-IFR-01	East	IFR	12R	12R	12L	11 12L	53	58	58

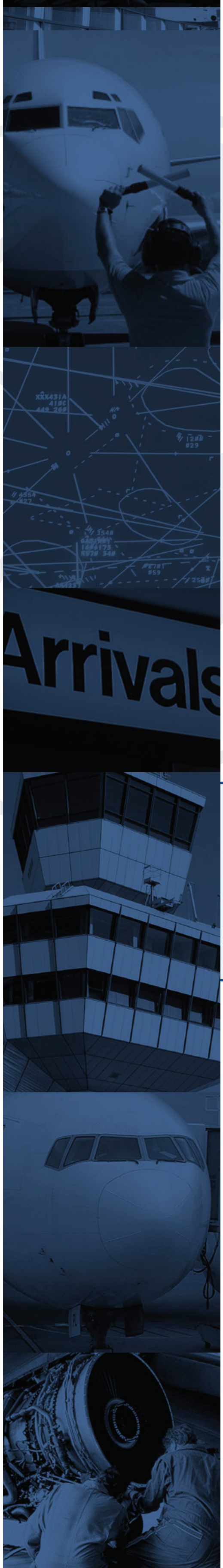
SJC's Average Delay is at Less than One Minute in East and West Flows

- **SJC operates to the West 93% of the time**
- **SJC East flow capacities are equal to or greater than West flow for some configurations**
- **Adjustments have been made to Delaysim analysis to prefer West flow when winds are light**

Average Minutes of Delays by Major Operating Conditions

Baseline 2007 and Forecast 2020 and 2035





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Regional Airport System Plan Update – *Final Scenario Analysis*

Prepared for:

Regional Airport Planning Committee

DRAFT REPORT

Prepared by:

SH&E, Inc.
an ICF International Company

January 5, 2010

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1 Study Background and Final Analysis Summary

1.1 Introduction

The overall goals of the Regional Aviation System Planning Update (RASP Study) are to determine when the Bay Area's primary commercial airports— Oakland International (OAK), San Francisco International (SFO), and San Jose International (SJC)—will reach their capacity limits, and to identify strategies other than new runway construction that will be most effective in allowing the region to accommodate future growth in aviation demand.

The RASP Study has forecast that passenger demand to and from the Bay Area's commercial airports will grow from 61 million passengers in 2007 up to approximately 101 million passengers (Base Case) in 2035. Based on this unconstrained demand forecast, it is expected that San Francisco International Airport will reach its runway capacity limits (assuming current Air Traffic Control procedures) sometime after 2020, and that by 2035 the airport will experience severe levels of aircraft delays. Oakland and San Jose are both projected to have available capacity over the forecast horizon and could handle an increased share of the region's demand.

In this report the effectiveness of various alternative strategies for accommodating the region's future demand is evaluated. The scenarios analyzed build upon the Mid-Point Screening analysis, which analyzed six strategies for accommodating Bay Area passenger demand. The strategies were evaluated independently as six distinct scenarios in the Mid-Point Screening analysis:

- Redistribution of Traffic Among the Primary Airports **(Scenario 1)**
- New Airline Service at Secondary Bay Area Airports **(Scenario 2)**
- New Airline Service at Airports Outside the Bay Area **(Scenario 3)**
- High-Speed Rail in the California Corridor **(Scenario 4)**
- New Air Traffic Control (ATC) Technologies **(Scenario 5)**
- Demand Management Strategies **(Scenario 6)**

In the mid-point screening, each scenario was evaluated against seven goals for the region:

1. **Reliable Runways -** Can we reduce flight delays and passenger inconvenience?
2. **Healthy Economy -** Can the region serve future aviation demand and support a healthy economy?
3. **Good Passenger Service -** Can we provide better service to the region's major air travel markets?
4. **Convenient Airports -** Can we maintain or improve airport ground access times and travel distances?
5. **Climate Protection** - Can we decrease Greenhouse Gas (GHGs) emissions from aircraft and air passengers traveling to airports?
6. **Clean Air** - Can we decrease air pollution from aircraft and air passengers traveling to airports?
7. **Livable Communities** - Can we avoid increasing the regional population exposed to aircraft noise?

Based on the results of the mid-point screening and input from RAPC and the public, the individual strategies were combined into two primary scenarios for further analysis: **Scenario A** and **Scenario B.**

Scenario A includes several strategies: traffic redistribution, modest improvements in ATC technologies, and demand management. **Scenario B** includes more aggressive traffic redistribution and demand management, the same ATC technologies as Scenario A, and passenger diversion to Sonoma County Airport. As in the Mid-Point Screening, each scenario was evaluated against seven goals for the region. A more thorough description of the scenarios is provided in Section 2.

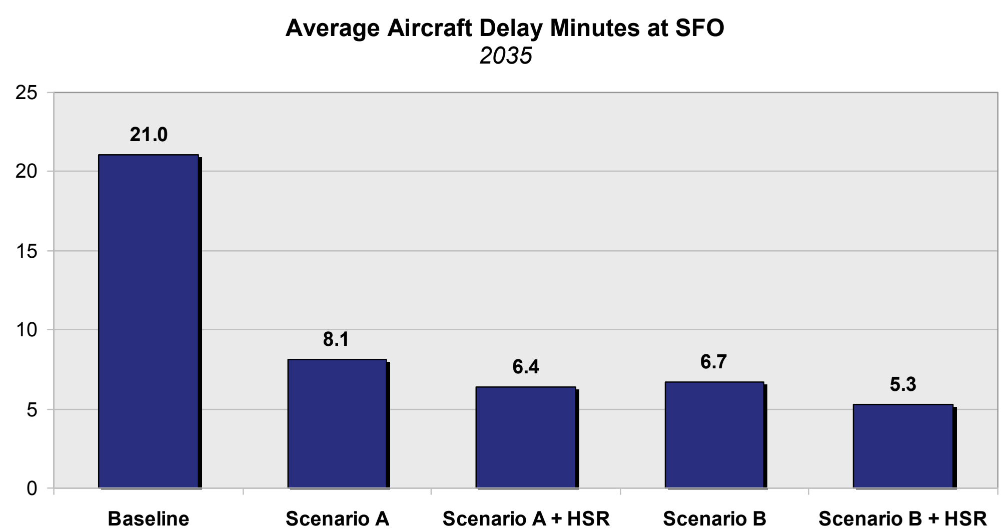
Since the High-Speed Rail Scenario is subject to several uncertainties mainly relating to funding, the timing of implementation, fares, and a potential competitive response from airlines, Scenarios A and B were also analyzed with and without high-speed rail, as outlined by the California High-Speed Rail Authority (CHSRA) plan.

Demand projections for Scenarios A and B are based on the Base Case demand forecast of 101 million annual passengers. A third scenario, **Scenario C**, was developed to assess how the region may accommodate passenger demand under the high growth assumptions. This scenario is based on the High Case passenger demand forecast (129 million passengers) and it incorporates all of the strategies analyzed in the mid-point screening analysis. The impact of Scenario C, including the full suite of potential ATC improvements, on average aircraft delays was estimated but its performance relative to the other study goals was not conducted because the Base Case forecast is viewed as the most likely forecast for Bay Area demand at this point in time.

1.2 SUMMARY OF RESULTS AND KEY CONCLUSIONS

All of the final scenarios are effective at reducing SFO delays by more than 50 percent to levels well below the 12 to 15-minute delay threshold. (See Exhibit 1-1) While most of the strategies analyzed in the Mid-Point Screening in isolation were not capable of reducing SFO delays below the defined thresholds, the final scenario analysis indicates that the region can effectively reduce future aircraft delays at SFO through a combination of natural market forces and individual strategies that include demand management policies at SFO and the pursuit and implementation of a realistic set of ATC improvements as in **Scenario A**. More aggressive demand management policies that would encourage a greater degree of traffic redistribution, and increased utilization of Sonoma County Airport, as in **Scenario B**, would produce additional delay reduction at SFO. The implementation of the CCSRA high-speed rail plan, as in **Scenarios A and B with HSR,** would further reduce SFO's average aircraft delays.

Exhibit 1-1: Final Scenarios Produce Significant Delay Reduction at SFO



As summarized in Exhibit 1-2, the scenarios produce mixed results for the goals that are not directly based on aircraft delays. If high-speed rail is implemented, it would enhance the performance of both scenarios for all of the goals.

Exhibit 1-2: Comparison of Screening Analysis Results by Scenario

Scenario:	Goal: Economy	Reliable Runways	Good Service	Convenient Airports	Climate Protection	Clean Air	Livable Communities
Metric:	*Average Aircraft Delay*	*Average Aircraft Delay*	*Flight Frequency in Top 15 O&D Markets*	*Average Ground Access Time*	*Green House Gases (CO2)*	*Hydrocarbons (Nox+VOCs)*	*Population in 65 CNEL*
Scenario A	🟢	🟢	🔴	🔴	🔴	🟡	🟡
Scenario A+HSR	🟢	🟢	🟢	🔴	🟡	🟢	🟡
Scenario B	🟢	🟢	🟡	🔴	🔴	🟡	🔴
Scenario B+HSR	🟢	🟢	🟢	🟡	🟡	🟢	🟡

Impact vs. Baseline		Improvement Criteria: Aircraft Delay	Improvement Criteria: All Other
🟢	High Impact	>= 50%	>= 10%
🟡	Medium Impact	15 to 49%	5 to 9%
🔴	Low Impact	< 15%	< 5 %

2 Description of Final Scenarios

2.1 Introduction

This section describes how the final scenarios are defined. Each of the primary scenarios (Scenario A and Scenario B) contains elements of the strategies that were evaluated individually in the Mid-Point Screening analysis. The specific strategies to include in each scenario was informed by the results of the Mid-Point Screening analysis and input from RAPC and the Task Force. In addition to Scenarios A and B, Scenario C which illustrates how the region may be able to accommodate future passenger demand in a high growth scenario, is also described in this section. While Scenarios A and B are fully evaluated against the seven study goals, Scenario C is not.

Exhibit 2-1: Final Scenarios

	Scenario A	Scenario B	Scenario C
Forecast Baseline Passengers	101M (Base Case)	101M (Base Case)	129M (High Case)
Traffic Redistribution	Original	Aggressive	Aggressive
Demand Management	Original	Aggressive	Aggressive
Internal Secondary Airports	-	Sonoma County	Sonoma County
External Airports	-	-	Sacramento, Stockton, Monterey
High Speed Rail	Analyzed With and Without	Analyzed With and Without	Included
ATC Technology	Partial	Partial	Full

2.2 Alternative Scenarios Defined

2.2.1 Scenario A

Scenario A consists of several strategies that were analyzed separately in the mid-point screening analysis:

- Traffic redistribution among the primary Bay Area airports;
- Demand management; and
- Some ATC technology improvements.

Traffic Redistribution

Scenario A assumes that increasing delays at SFO will cause some airlines to naturally shift capacity to the uncongested OAK and SJC airports without any direct intervention. Excessive delays at SFO will increase the cost of using SFO for both airlines and passengers and create natural incentives for airlines and passengers to make greater use of available capacity at OAK and SJC. As in the Redistribution Scenario (Scenario 1), Scenario A assumes that SFO continues to function as an international gateway and that domestic O&D passengers are the most likely category of passengers to shift to the other airports.

Demand Management

Scenario A also assumes that SFO management would implement some form of demand management to deal with the projected level of delays. In addition to traffic redistribution, Scenario A includes the same types of demand management strategies at SFO that were analyzed in Scenario 6 for the Mid-Point Screening. As in Scenario 6, demand management is assumed to be in effect during the peak morning/early afternoon period from 8:00 am to 1:59 pm, when hourly activity is highest. Scenario A assumes that airlines will respond to demand management by rescheduling some small passenger aircraft flights (i.e., turboprops and RJs with less than 100 seats) and some narrowbody aircraft to avoid the peak period and that all small aircraft flights remaining in the peak period will be up-gauged to a jet aircraft with 100 seats. Additionally, Scenario A assumes that flights to the close-in markets (i.e., Modesto, Chico and Crescent City) that mainly carry passengers who connect to other flights at SFO, will be replaced with frequent bus service.

In terms of general aviation, demand management assumes that GA operations are held constant at the 2007 level. Forecast growth in GA demand is instead handled by GA reliever airports in the Bay Area such as Half Moon Bay Airport, ,Hayward

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Airport, Gnoss Field, Livermore Municipal Airport, Napa County Airport, and Palo Alto Airport. Remaining GA operations during the peak period are limited through a slot reservation system to 4 operations (2 arrivals and 2 departures) per hour. GA operations that can not be accommodated during the peak period are assumed to operate during the off-peak hours.

ATC Improvements

Scenario A also assumes ATC improvements, but only a sub set of the ATC technologies that were studied in Scenario 5. The ATC improvements included in Scenario A are those that are most likely to be implemented over the study timeframe: (1) improved Simultaneous Offset Instrument Approaches (SOIA) at SFO; (2) a relocated glideslope antenna on the Runway 11 end at OAK, and reduced aircraft separations through RNP/RNAV on morning departures routes shared by OAK and SFO; and (3) Center TRACON automation (CTAS). ˜ Reducing the minimum ceiling to 1,600 ft from 2,100 ft for SOIA operations at SFO would allow SOIA operations to be conducted more frequently and would increase the aircraft arrival rate during marginal weather conditions. Relocation of the glideslope antenna at OAK would reduce the excessive delays that occur today under IFR conditions with landings and takeoffs from west to east. CTAS, which would be deployed at all three airports, is a computer tool that can be used by air traffic controllers to reduce the average separation time between arriving aircraft, which would result in more runway throughput and fewer aircraft delays.

The implementation of other ATC improvements that were analyzed in Scenario 5 but are not included in Scenario A is less certain. The previously studied ATC technologies that are not part of Scenario A are: (1) Airport Surface Detection Equipment (ASDE-X), which enhances taxiway flows and reduce runway conflicts under non-visual conditions; (2) extensive use of new Required Navigational Performance (RNP/RNAV routes and procedures, which permit more flexible and efficient arrival/departures; (3) Cockpit Display of Traffic Information Assisted Visual Separation (CAVS), which would help reduce aircraft separations in non-visual conditions and would significantly benefit SFO by facilitating paired approaches on its closely spaced parallel runways under these conditions; and (4) Wake Vortex Advisory System (WVAS), which reduces wake vortex separations between aircraft under certain wind conditions.

2.2.2 Scenario B

Scenario B is similar to Scenario A except that Scenario B assumes a greater redistribution of airline services and passenger demand from SFO to OAK and SJC, and expanded use of Sonoma County Airport for airline passenger service. The specific elements of Scenario B are:

- Major traffic redistribution;
- Aggressive Demand Management;
- Diversion to Sonoma County Airport; and
- Some ATC technology improvements.

Major Traffic Redistribution and Aggressive Demand Management

Scenario B assumes that aggressive demand management policies at SFO result in a greater shift of airline services and passengers to OAK and SJC beyond what natural market forces (i.e., rising delays at SFO) would accomplish in Scenario A. SFO would implement a more comprehensive demand management program to not only control its own delays, but as part of a larger regional approach to make use of available capacity at OAK and SJC. Such strategies could include a strong congestion pricing approach for limiting delays or new requirements for airlines to increase their use of larger aircraft. Further, if delays at SFO become very severe and begin to affect the efficiency of the National Airspace System, the FAA could intervene with administrative measures such as a cap on hourly operations to reduce activity and delays at SFO, as it has done at Chicago O'Hare and the New York City airports.

Diversion to Secondary Bay Area Airports

In addition to a redistribution of passengers between the primary Bay Area airports, Scenario B assumes that some additional passengers are diverted to Sonoma County Airport as airlines add new routes and frequencies (as in Scenario 2). However, Scenario B does not assume any air passenger diversion to Buchanan Field or Travis Air Force Base as these airports do not currently support commercial airline services and considerable efforts would be needed to attract airlines and passengers to these airports and to develop the requisite facilities. Furthermore, in the current airline industry environment, airlines are reducing service in less profitable secondary markets and are less like to test new markets than in the past..

ATC Improvements

Scenario B includes the same ATC technologies as Scenario A.

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2.2.3 Scenario C

The Mid-Point Screening was based on detailed analysis of various scenarios assuming the Base Case demand forecast of 101 million passengers in 2035. Scenario C, on the other hand, is intended to provide a conceptual approach for accommodating the High Forecast of 129 million annual air passengers in the Bay Area, also without construction of new runways at SFO or OAK. Because of the increased levels of Bay Area passenger, air cargo and general aviation activities associated with the High Forecasts, virtually all of the original six strategies evaluated would need to be employed to allow Bay Area airports to serve this level of demand without incurring significant capacity problems and delays..

The specific strategies included in Scenario C are:

- Major traffic redistribution;
- Aggressive Demand Management;
- Passenger Diversion to Sonoma County Airport;
- Passenger Diversion to the external airports (Monterey, Sacramento and Stockton);
- High-Speed Rail in the California Corridor; and
- Full Suite of ATC technology improvements.

Under the High Forecast assumptions, Scenario C assumes a significant redistribution of domestic local passenger demand from SFO to OAK and SJC. Airport traffic redistribution would be accomplished through a combination of natural market forces and very aggressive demand management policies similar to Scenario B. In terms of the use of alternative airports, Scenario C assumes that additional airline services at Sonoma County Airport and the neighboring external airports, Monterey, Sacramento and Stockton, would encourage passenger diversion from the primary Bay Area airports. However, Scenario C does not assume the use of Travis AFB or Buchanan Field, which currently do not support commercial airline services, for the reasons previously noted. The implementation of High-Speed Rail and the full suite of ATC technologies that were analyzed in the Mid-Point Screening are also assumed in the high growth scenario.

Scenario C is meant to illustrate how the Bay Area airport system might function under a high growth scenario. Average aircraft delays at the primary airports are estimated based on the detailed modeling conducted for the Mid-Point Screening analysis. However, the performance of Scenario C against the other study goals was not conducted because the Base Case forecast is viewed as the most likely forecast for Bay Area demand at this point in time. Should the high forecast become more plausible, an analysis of the goals will need to be conducted.

3 IMPACTS OF FINALS SCENARIOS ON AIRPORT ACTIVITY AND DELAYS

3.1 INTRODUCTION

This section describes the impacts of each scenario on airport operations and delays over the forecast period. In each scenario, aircraft activity declines at SFO and increases at OAK and SJC as a result of traffic redistribution. Some elements of demand management at SFO (Scenarios A and B) also cause a decrease in airport activity at SFO by shifting air passenger demand to other airports and modes or through up-gauging of passenger aircraft. ATC, which is included in both scenarios, increases airport capacity and reduces aircraft delays for a given level of aircraft activity. For each scenario, the specific assumptions that drive the projection of aircraft operations are described and forecast aircraft operations are compared to the Baseline forecast. In addition, average aircraft delays for each scenario are summarized and compared to the Base Case.

3.2 SCENARIO A

3.2.1 Forecast Airport Activity

Airport Passengers

Scenario A assumes the same redistribution of traffic among the Bay Area airports that was assumed in Scenario 1. The excessive congestion and delays forecast at SFO are expected to lead to higher costs for both airlines and passengers and as a result, growth at SFO will naturally slow down. As in the original Traffic Redistribution Scenario, by 2035 both OAK and SJC are assumed to return to their historic peak shares of Bay Area domestic local traffic: OAK's peak historic share was 33 percent and SJC's was 26 percent. Under these assumptions, approximately 4.3 million annual domestic O&D passengers are shifted from SFO to OAK and SJC in 2035. As a result, OAK gains an additional 2.4 million passengers and passengers at SJC increase by 1.9 million. (See Exhibit 3-1).

Exhibit 3-1: Forecast Passengers for Scenario A

Scenario	Passengers (millions)			
	OAK	SFO	SJC	Total
Base Case	**20.7**	**64.4**	**16.3**	**101.3**
Redistribution	2.4	(4.3)	1.9	(0.0)
Bus Substitution	-	(0.2)	-	(0.2)
Scenario A	**23.1**	**59.9**	**18.2**	**101.1**
Percent of Total	**22.8%**	**59.2%**	**18.0%**	**100.0%**
% Change vs. Base Case	11.6%	-7.0%	11.8%	-0.2%

In addition to the impact of Traffic Redistribution on airport passenger levels, the bus substitution component of Demand Management reduces SFO traffic by approximately 177,000 passengers. For Scenario A, total passenger traffic at SFO in 2035 is forecast at 59.9 million, or 59 percent of total Bay Area passenger demand. Passenger traffic at OAK increases by 11.6 percent from 20.7M to 23.1M. At SJC, passenger traffic is projected to increase by 11.8 percent from 16.3M to 18.2M. The resulting distribution of passengers by airport is similar to the traffic split analyzed in Scenario 1.

Aircraft Operations

Under Scenario A aircraft operations at SFO in 2035 are forecast at 469,000 compared to 527,000 for the Baseline. (See Exhibit 3-2) Aircraft operations at SFO decline due to traffic redistribution to OAK and SJC, as well as demand management which reduces aircraft activity through bus substitution in close-in markets, aircraft up-gauging and the cap on GA operations

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Exhibit 3-2: Forecast Aircraft Operations for Scenario A

Scenario	Aircraft Operations OAK	SFO	SJC	Total
Base Case	355,000	527,000	243,000	1,124,000
Redistribution	22,000	(37,000)	18,000	3,000
Bus Substitution	-	(6,000)	-	(6,000)
Upgauging to 100 -seat Aircraft	-	(5,000)	-	(5,000)
GA Cap	-	(10,000)	-	(10,000)
Scenario A	377,000	469,000	261,000	1,107,000
Percent of Total	34.1%	42.4%	23.6%	100.0%
% Change vs. Base Case	6.2%	-11.0%	7.4%	-1.5%

The combined aircraft operations at OAK and SJC increase by 40,000, slightly more than the reduction at SFO due to traffic redistribution (37,000) because the average aircraft size for domestic services is lower at OAK and SJC than at SFO, requiring more aircraft operations to accommodate the same number of passengers.

3.2.2 Estimated Airport Delays

The ATC improvements included in Scenario A combined with lower aircraft activity levels significantly reduce average aircraft delays at SFO from 21 minutes in the Base Case to approximately 8 minutes in Scenario A. (See Exhibit 3-3) Average aircraft delays increase at the other Bay Area airports because the increased activity resulting from traffic redistribution offsets any delay reduction from the ATC improvements. However, the increases at the other airports are small and the average delays remain well below the congestion threshold. At OAK, average aircraft delay increases by less than one minute from approximately 3.5 minutes in the Base Case to 4.4 minutes in Scenario A. The increase is immaterial at SJC, where average delay remains under 0.5 minutes in Scenario A.

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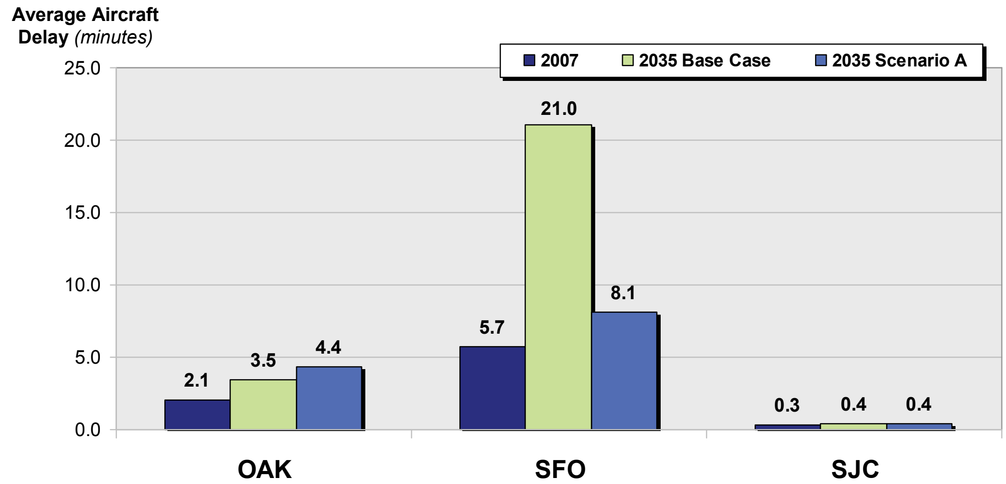
Exhibit 3-3: Forecast Aircraft Delays for Scenario A



3.2.3 High-Speed Rail Sensitivity Analysis

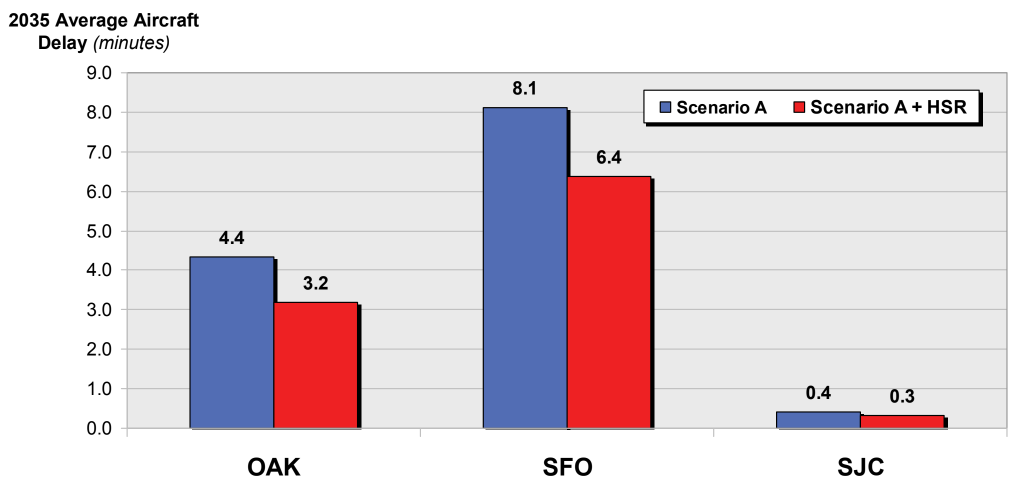
In Scenario 4, the planned High-Speed Rail between Northern and Southern California was estimated to divert 6.1 million passengers and 68,000 annual aircraft operations from the primary Bay Area airports. If High-Speed Rail is implemented along with the strategies in Scenario A, forecast 2035 airport passengers at the Bay Area airports would decrease from 101 million to 95 million. (See Exhibit 3-4)

Exhibit 3-4: Forecast Airport Activity for Scenario A + High-Speed Rail

	OAK	SFO	SJC	Total
Passengers (millions)				
Scenario A	**23.1**	**59.9**	**18.2**	**101.1**
less HSR Diversion	(1.8)	(2.4)	(1.9)	(6.1)
Scenario A with HSR	**21.3**	**57.4**	**16.3**	**95.0**
Aircraft Operations				
Scenario A	**377,000**	**469,000**	**261,000**	**1,107,000**
less HSR Diversion	(18,000)	(27,000)	(22,000)	(68,000)
Scenario A with HSR	**359,000**	**442,000**	**238,000**	**1,040,000**

With High-Speed Rail services, average aircraft delays at SFO decline further, from 8.1 minutes without HSR (Scenario A) to 6.4 minutes with HSR (Scenario A + HSR). Since future High-Speed Rail service would divert passengers from all three airports, average aircraft delays fall for each airport compared to Scenario A without HSR. (See Exhibit 3-5)

Exhibit 3-5: Forecast Aircraft Delays for Scenario A and Scenario A + HSR



3.3 Scenario B

3.3.1 Forecast Airport Activity

Airport Passengers

Scenario B assumes more aggressive demand management policies than those assumed in Scenario A (and Scenario 6), which results in a greater degree of traffic redistribution. Demand Management in Scenario B assumes that additional traffic redistribution will occur in domestic O&D passenger markets where SFO was forecast to have a market share of 40 percent or greater in the Base Case. For these markets an airport allocation of OAK 35 percent, SFO 33 percent, and SJC 32 percent was assumed. The airport allocation assumptions were based on actual airport O&D shares in markets with effective nonstop service from each airport in 2Q 2008. Traffic was only redistributed in markets that could support a minimum of 2 daily departures from each of the Bay Area airports. Domestic connecting passengers were also redistributed across the airports based on the ratio of connecting to local traffic in the Base Case.

With more aggressive demand management, 7.5 million passengers (see Exhibit 3-6) are shifted from SFO to the other primary airports in Scenario B compared to 4.3 million in Scenario A (see Exhibit 3-1). OAK gains 3.8 million passengers and SJC's passenger traffic increases by 3.7 million.

Exhibit 3-6: Forecast Passengers for Scenario B

Scenario	Passengers (millions)			
	OAK	SFO	SJC	Total
Base Case	**20.7**	**64.4**	**16.3**	**101.3**
Redistribution	3.8	(7.5)	3.7	0.0
Diversion to Sonoma County	(0.3)	(0.4)	(0.0)	(0.7)
Bus Substitution	-	(0.2)	-	(0.2)
Scenario B	**24.1**	**56.3**	**20.0**	**100.4**
Percent of Total	**24.0%**	**56.1%**	**20.0%**	**100.0%**
% Change vs. Base Case	16.6%	-12.5%	22.9%	-0.9%

The Demand Management element of Scenario B assumes bus substitution in the close-in markets (i.e., Modesto, Chico and Crescent City) at SFO which further reduces SFO passenger demand by approximately 177,000 passengers. In addition, Scenario B includes greater use of Sonoma County Airport, which reduces SFO passenger demand by 0.4 million and OAK passengers demand by 0.3M.

The 2035 forecast for total passengers at the primary airports is 100.4 million for Scenario B. Passenger traffic at SFO in 2035 is forecast at 56.3 million compared to nearly 60 million in Scenario A. Passenger traffic at OAK increases from 20.7 million (Base Case) to 24.1 million. At SJC, passenger traffic is projected to increase 16.3M (Base Case) to 20 million.

Aircraft Operations

Aircraft operations at SFO in 2035 are forecast to decline to 441,000 in Scenario B compared to 527,000 for the Baseline. (See Exhibit 3-7) Aircraft operations at SFO decline due to traffic redistribution to OAK and SJC, greater use of Sonoma County Airport, and demand management policies which reduce aircraft activity through bus substitution, greater use of larger aircraft, and limits on GA activity.

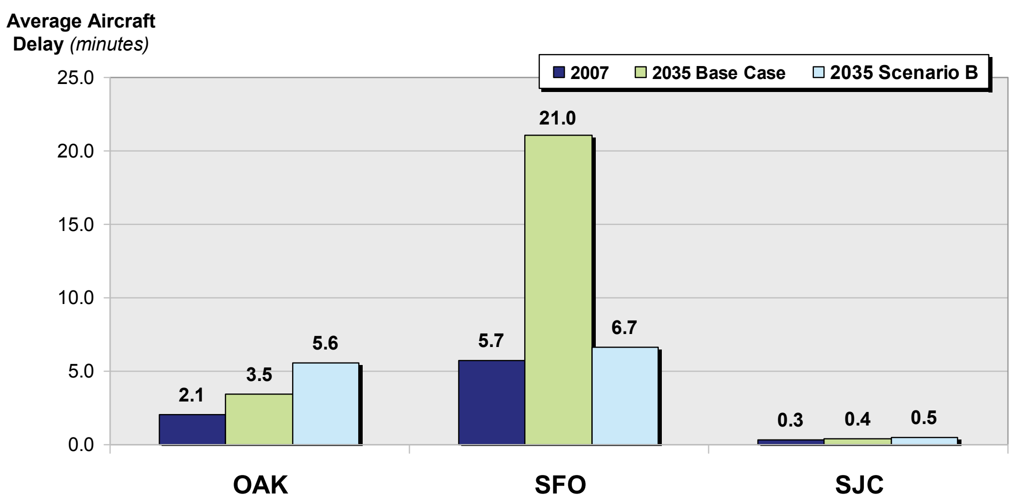
Exhibit 3-7: Forecast Aircraft Operations for Scenario B

	Aircraft Operations			
	OAK	SFO	SJC	Total
Base Case	355,000	527,000	243,000	1,124,000
Redistribution & Diversion to Sonoma County	32,000	(68,000)	35,000	(1,000)
Bus Substitution	-	(3,000)	-	(3,000)
Peak Period Upgauging to 100 -seat Aircraft	-	(5,000)	-	(5,000)
GA Cap	-	(10,000)	-	(10,000)
Scenario B	387,000	441,000	278,000	1,105,000
Net Change	32,000	(86,000)	35,000	(19,000)
Percent Change	9.0%	-16.3%	14.4%	-1.7%

3.3.2 Estimated Airport Delays

Scenario B also produces significant delay reduction benefits at SFO by lowering average delay per aircraft from 21 minutes in the Base Case to 6.7 minutes. Average delay increases moderately at OAK from 3.5 minutes in the Base Case to 5.6 minutes, but remains well below the congestion threshold. Average delay at SJC is barely impacted, increasing slightly from 0.4 minutes to 0.5 minutes. (See Exhibit 3-8).

Exhibit 3-8: Average Aircraft Delays by Airport for Scenario B



3.3.3 High-Speed Rail Sensitivity Analysis

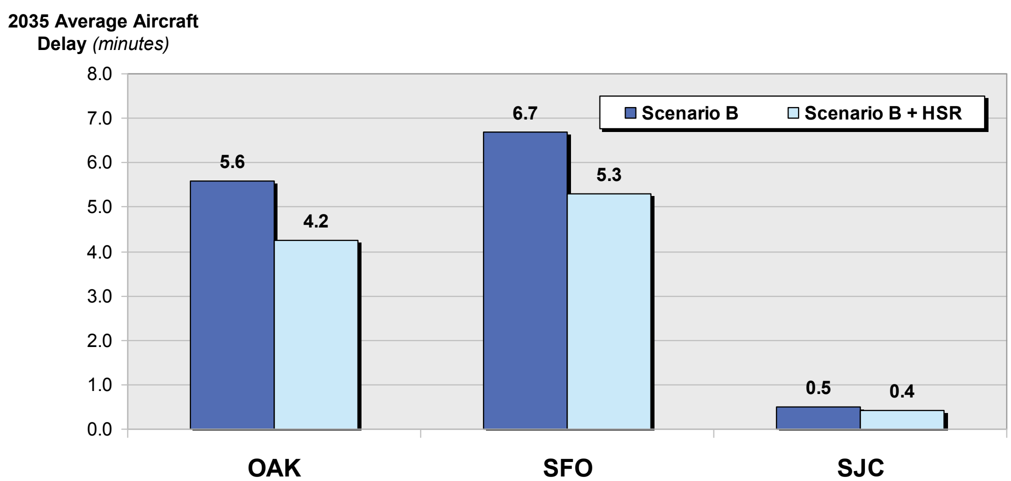
If High-Speed Rail in the California corridor is implemented in addition to the strategies analyzed in Scenario B, forecast 2035 demand for the Bay Area airports would decrease from 100 million passengers to 94 million passengers. Annual aircraft operations would fall from 1.1 million to 1.0 million (see Exhibit 3-9).

Exhibit 3-9: Forecast Airport Activity for Scenario B + High-Speed Rail

	OAK	SFO	SJC	Total
Passengers (millions)				
Scenario B	**24.1**	**56.3**	**20.0**	**100.4**
less HSR Diversion	(1.8)	(2.4)	(1.9)	(6.1)
Scenario B with HSR	**22.3**	**53.9**	**18.1**	**94.3**
Aircraft Operations				
Scenario B	**387,000**	**441,000**	**278,000**	**1,106,000**
less HSR Diversion	(18,000)	(27,000)	(22,000)	(68,000)
Scenario B with HSR	**369,000**	**414,000**	**256,000**	**1,038,000**

The combination of Scenario B and High-Speed Rail would lower average aircraft delays at SFO to 5.3 minutes in 2035 compared to 6.7 minutes without HSR and 21 minutes in the Base Case. (See Exhibit 3-10) High-Speed Rail also produces delay reduction benefits at OAK, lowering the average delay per aircraft from 5.6 to 4.2 minutes.

Exhibit 3-10: Forecast Aircraft Delays for Scenario B and Scenario B + HSR



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3.4 Scenario C

3.4.1 Forecast Airport Activity

Airport Passengers and Aircraft Operations

Scenario C is intended to illustrate how the region may be able to meet passenger demand under the High Forecast. The detailed assessment of baseline airport passenger levels and how each strategy may affect airport activity levels that was conducted in the Mid-Point Screening and for Scenarios A and B was not conducted for Scenario C. Instead it was assumed that each of the primary airports would operate at full capacity in Scenario C, based on the general capacity constraints described by each airport operator.

Exhibit 3-11 summarizes forecast passengers and aircraft operations for Scenario C. At maximum capacity, the primary airports are assumed to accommodate 117 million passengers, or approximately 91 percent of total forecast passenger demand in the High Forecast (129 million passengers). SFO would account for 56 percent, or 65 million passengers. OAK would accommodate 28 million annual passengers (the upper capacity of its main runway) and SJC would accommodate 24 million passengers (based on having 40 airline gates). The remaining 9 percent of total regional demand would primarily shift to HSR or other airports (Sonoma County, Monterey, Sacramento or Stockton)[1].

Exhibit 3-11: Scenario C Forecast Passengers and Aircraft Operations by Primary Airport, *2035*

	Scenario C - 2035				Airport Shares		
	OAK	SFO	SJC	Total	OAK	SFO	SJC
Passengers (millions)	28	65	24	117	24%	56%	21%
Aircraft Operations	446,000	536,000	336,000	1,318,000	34%	41%	25%

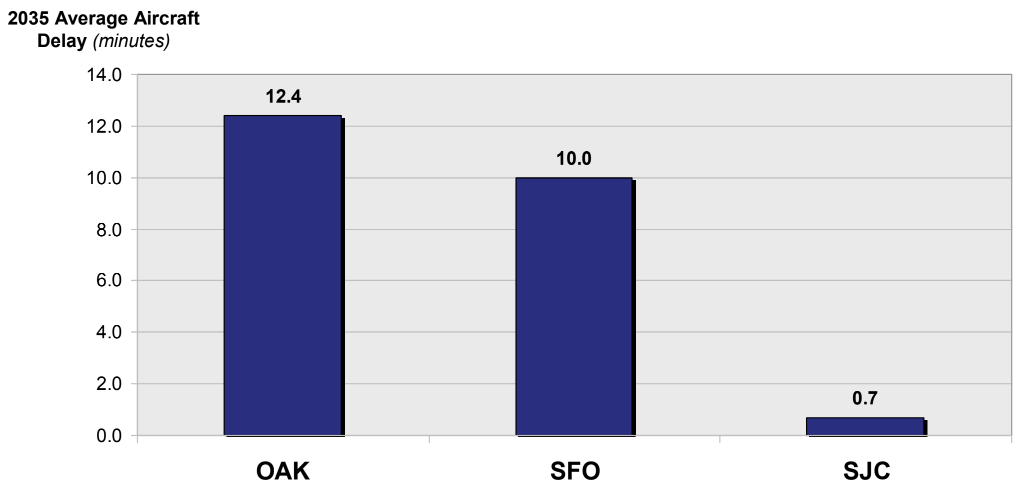
In 2035, annual aircraft operations at the primary airports under the High Forecast are estimated at 1.3 million. By airport, aircraft operations are forecast at 536,000 for SFO, 446,000 for OAK and 336,000 for SJC.

[1] Approximately 200,000 passengers from markets in close proximity to SFO would be shifted to bus services through demand management policies.

3.4.2 Estimated Airport Delays

For Scenario C the average aircraft delays at each of the airports were extrapolated from delay curves developed for the Mid-Point Screening analysis and assume all of the ATC improvements and new technologies that were analyzed in Scenario 5. OAK is estimated to have the highest average delay at 12.4 minutes per aircraft. (See Exhibit 3-12) Average aircraft delay at SFO is estimated at 10 minutes. Aircraft delays at SJC are very low at 0.5 minutes even in the High Forecast. However, at SJC the limiting constraint is the terminal facility and not the airside. If some of the ATC technologies are not deployed, estimated average aircraft delays would increase.

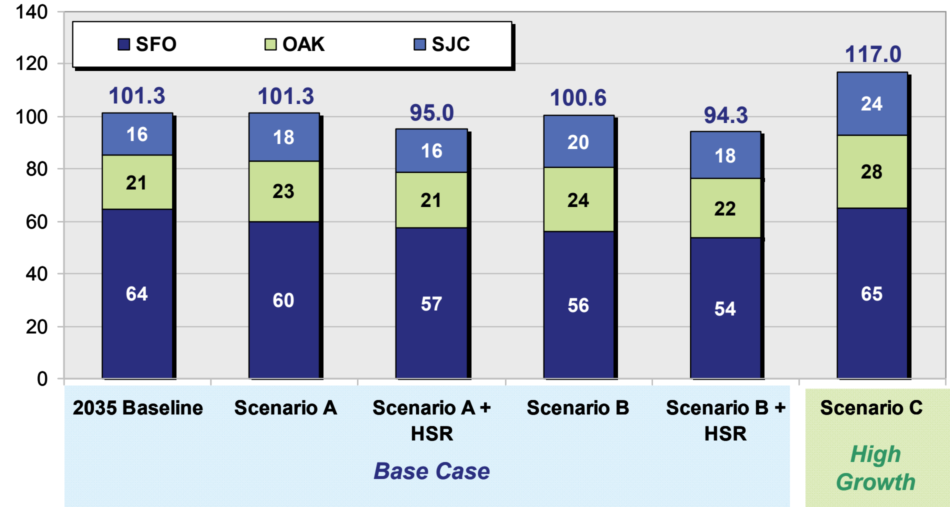
Exhibit 3-12: Estimated Aircraft Delays for Scenario C



3.5 Comparison of Airport Activity Levels and Aircraft Delays by Scenario

The number of passengers accommodated at the primary Bay Area airports ranges from the high of 101 million annual passengers in the Baseline and Scenario A to 94 million in Scenario B with High-Speed Rail. (See Exhibit 3-13) A total of 7 million passengers in Scenario B are projected to utilize other modes (i.e., bus service to SFO or California corridor High-Speed Rail) or Sonoma County Airport. In Scenario C, which is based on the High Forecast, the primary airports accommodate 117 million passengers compared to a total of 129 million passengers overall. In Scenario C, approximately 12 million passengers are forecast to utilize other modes or other airports, including the external airports (i.e., Sacramento, Monterey and Stockton).

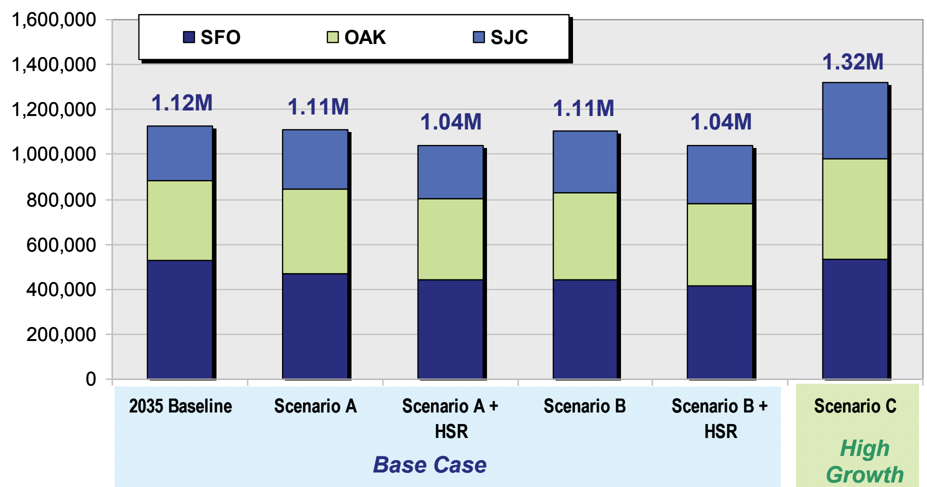
Exhibit 3-13: Comparison of Forecast 2035 Passenger Demand by Primary Airport and Scenario *(millions)*



Note: Excludes passengers diverted to secondary Bay Area airports, external airports or high-speed rail.

Aircraft operations by airport and by scenario are presented in Exhibit 3-14. For the Base Case growth forecast, aircraft operations range from 1.12 million in the Baseline to approximately 1.04 million for Scenario A with High-Speed Rail and Scenario B with High-Speed Rail. For Scenario C, which is based on the High Forecast, aircraft operations reach 1.32 million.

Exhibit 3-14: Comparison of Forecast 2035 Aircraft Operations by Primary Airport and Scenario



Note: Excludes aircraft operations at secondary Bay Area airports or external airports.

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In terms of average aircraft delays, which are summarized in Exhibit 3-15, Scenario B with High-Speed Rail has the greatest impact on average delays. In this scenario the combination of natural market shifts, aggressive demand management, expanded Sonoma County air services, High-Speed Rail and expected ATC improvements lowers average aircraft delays at SFO by 75 percent from 21 minutes to 5.3 minutes. Scenario A with High-Speed Rail and Scenario B (without High-Speed Rail) produce similar results with average SFO delays of 6.4 and 6.7 minutes, respectively. Scenario A alone, which includes market driven traffic redistribution, some degree of demand management and the same partial set of ATC technologies that were analyzed in Scenario B, reduces SFO aircraft delays to approximately 8 minutes per operation. While Scenario A produces lower delay reduction benefits, it still results in average SFO delays within the study's parameters for acceptable delay of 12 to 15 minutes.

Exhibit 3-15: Comparison of Average Aircraft Delay Minutes by Primary Airport and Scenario

Scenario	Forecast	OAK	SFO	SJC
Base Case	Base	3.47	21.03	0.37
Scenario A	Base	4.35	8.12	0.40
Scenario A + HSR	Base	3.19	6.36	0.33
Scenario B	Base	5.59	6.68	0.50
Scenario B + HSR	Base	4.24	5.31	0.41
Scenario C	High	12.40	10.00	0.70

Scenario C, which reflects the High Forecast, produces the highest levels of aircraft delay of all the scenarios. With the full set of ATC improvements assumed in Scenario C, average delay at SFO is 10 minutes, which is still in the acceptable range. Average aircraft delay at OAK reaches 12 minutes, mainly as a result of the increased demand accommodated at OAK in this scenario (i.e., OAK handles 33 percent more passengers than in the 2035 Base Case forecast). As with all the scenarios, aircraft delays at SJC, are negligible and demand could likely be handled by the terminals with 40 airline gates. .

4 Impacts of Final Scenarios on Study Goals

4.1 Introduction and Background

This section describes and summarizes the impacts of the final scenarios on the study goals: (1) reliable runways; (2) healthy economy; (3) good passenger service; (4) convenient airports; (5) climate protection; (6) clean air; and (7) livable communities. Exhibit 4-1 summarizes the metrics used to evaluate the performance of each scenario against the study goals.

Exhibit 4-1: Final Analysis Screening Goals and Performance Measures

Goal	Performance Measure
Reliable Runways	1. Average Aircraft Delays 2. Average 3-Hour Peak Delays
Healthy Economy	Primary Airports Have Adequate Capacity to Accommodate Forecast Demand
Good Passenger Service	Flights per Capita to Top Domestic Destinations
Convenient Airports	1. Average Access Time 2. Average Access Distance
Climate Protection	Green House Gas Emissions from Aircraft and Ground Access Vehicles
Clean Air	Criteria Pollutant Emissions (HC+NOx) from Aircraft and Ground Access Vehicles
Livable Communities	1. 65 CNEL Population 2. 55 CNEL Population

The performance of the scenarios against the goals depends on several underlying factors. The dominant factor is the number of forecast annual aircraft operations, which affects airport capacity, air emissions and noise exposure. Total aircraft operations at the primary Bay Area airports are forecast to increase by 24 percent between 2007 and 2035 in the Base Case and by 53 percent in the High Forecast.

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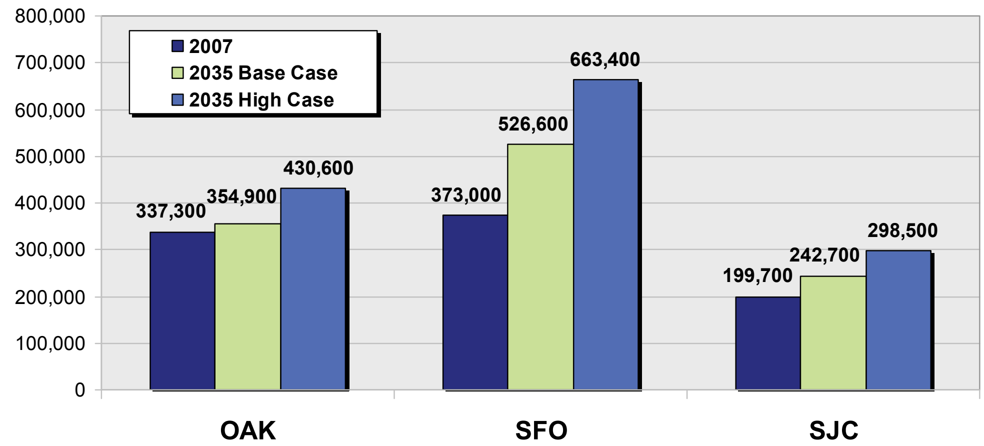
Aircraft operations are forecast to grow the fastest at SFO, increasing by 41 percent in the Base Case forecast and by 87 percent in the High Forecast. (See Exhibit 4-2)

Exhibit 4-2: Base Year and Forecast Aircraft Operations, by Airport



Other factors that influence scenario performance include the aircraft fleet mix, airline schedules, and aircraft delays. The forecast aircraft fleets, which also serve as inputs to the air quality and noise modeling, reflect changes in aircraft types, aircraft fuel efficiency and aircraft noise characteristics. The hourly timing of airline flights can contribute to aircraft delays during peak periods of activity and late night flights have a higher weighting than day and evening flights in the noise modeling. Finally, while aircraft delay is a performance measure it can also contribute to increased GHGs and air emissions by lengthening aircraft taxi times. Similarly, aircraft average delay can contribute to greater levels of noise exposure as aircraft flights are delayed into the noise sensitive evening and nighttime hours.

All of the scenarios result in fewer aircraft operations in the Bay Area region than in the 2035 Baseline. (See Exhibit 4-3) Scenarios that include High-Speed Rail have the lowest number of region-wide aircraft operations, since more than 6 million air passengers are projected to shift from air to rail in these scenarios.

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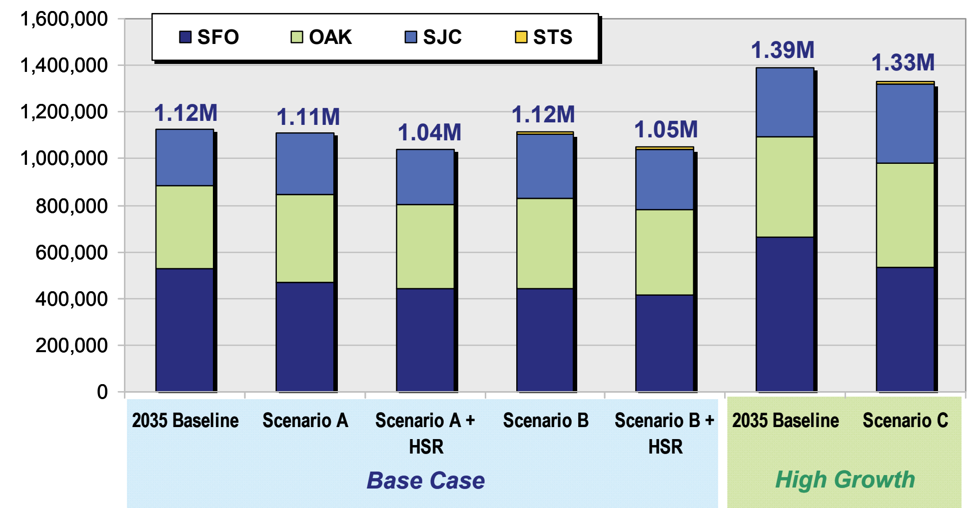
Exhibit 4-3: Forecast Aircraft Operations by Scenario, 2035



Note: Operations shown for Sonoma County Airport reflect only the incremental activity that results from diversion from the primary Bay Area airports.

4.2 Reliable Runways

A critical goal of the study is the reduction of aircraft flight delays and air passenger inconvenience in the Bay Area. Two measures are used to evaluate scenario performance against the reliable runways goal: (1) average aircraft delay in minutes and (2) average aircraft delay for the busiest three-hour period. The scenarios are evaluated solely in terms of average delays at SFO, which in the Baseline forecast is the only airport that reaches capacity over the forecast period. The results for each of reliable runways metrics are discussed in the following sections.

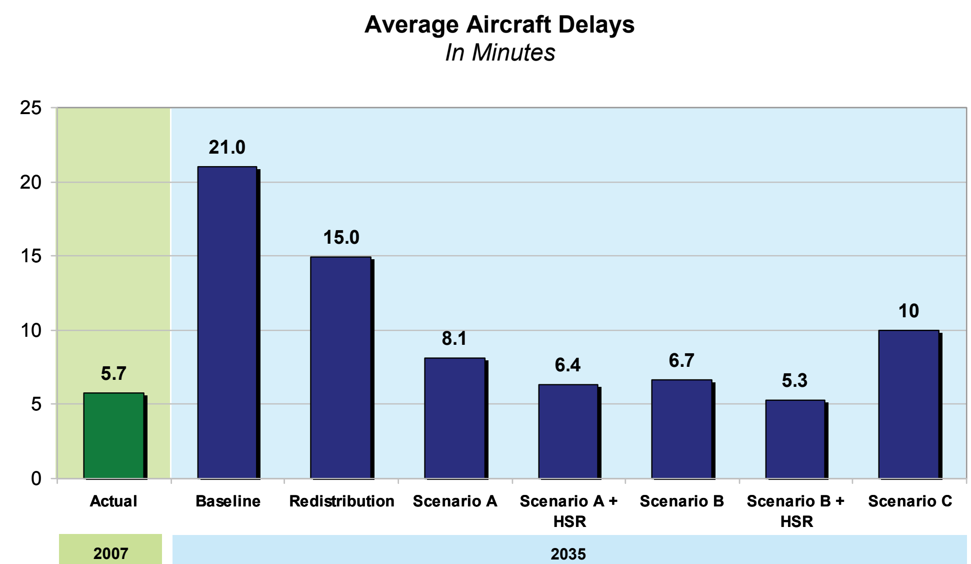
4.2.1 Average Aircraft Delays

The scenario forecasts of aircraft operations and fleet mix served as inputs to the capacity and delay models, as described in the *Baseline Runway Capacity and Delays* report, to determine the average aircraft delay at SFO in each final scenario. A threshold level of 12 to 15 minutes of average aircraft delays was used in the Baseline capacity analysis to estimate the maximum number of annual aircraft operations that an airport's runway system could handle without excessive delays. The same delay threshold was used to assess the performance of each scenario in meeting the Reliable Runways goal.

Under the Baseline forecast, average aircraft delays at SFO increase from 5.7 minutes in 2007 to 21.0 minutes in 2035. (See Exhibit 4-4) Estimated average aircraft delays at SFO are 8.1 minutes for Scenario A and 6.7 minutes for Scenario B, which includes more aggressive demand management and air passenger redistribution than Scenario A as well as passenger diversion to Sonoma County Airport. In both cases, if High-Speed Rail were implemented the average aircraft delay would fall further to 6.4 minutes for Scenario A and 5.3 minutes for Scenario B.

Scenario A, which includes demand management and some ATC improvements as well as market driven traffic redistribution, produces significantly more delay reduction that Traffic Redistribution alone. The Traffic Redistribution scenario that was analyzed in the Mid-Point Screening resulted in 15 minutes of aircraft delay at SFO, compared to 8 minutes for Scenario A.

Exhibit 4-4: Average Aircraft Delays at SFO, by Scenario



Scenario C, which is based on the High Forecast and includes all of the strategies analyzed in the Mid-point Screening[2], results in 10 minutes of delay per aircraft operation at SFO, largely due to the assumption that the full suite of new ATC Technologies would be in place helping to reduce delays. Average delays at each primary Airport for the High Forecast were not modeled because the Base Case

[2] While Scenario C includes diversion to secondary internal airports, it only considers Sonoma County Airport, whereas the Internal Secondary Airports scenario analyzed in the Mid-Point Screening also included Travis AFB and Buchanan Field.

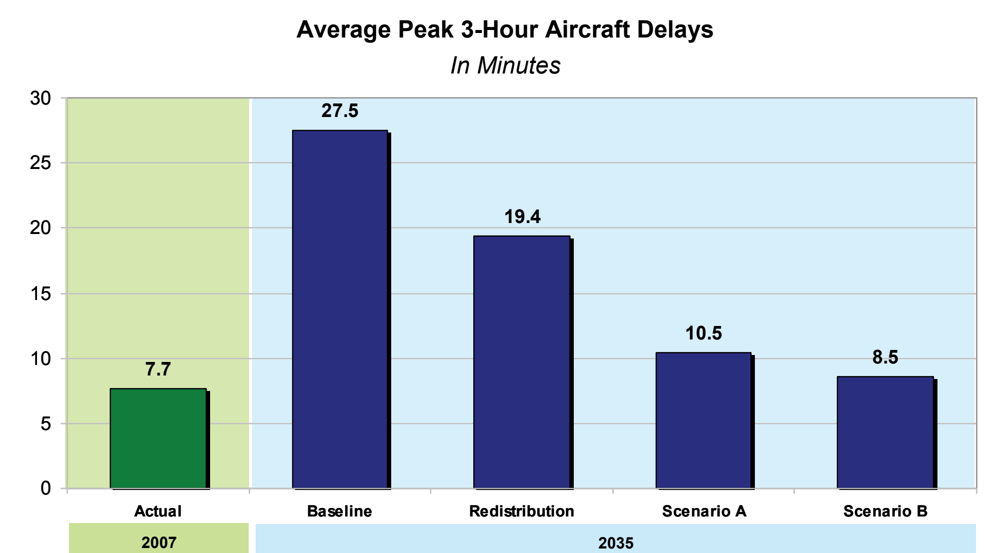
forecast is viewed as the most likely projection of future airport demand. The estimates rely on airport delay curves previously developed for the original set of Scenarios under the Baseline forecasts as well as an estimate of the impact of new ATC technologies.

4.2.2 Average 3-Hour Peak Period Delays

A second delay measure that quantifies the average delay during the most delayed three-hour period was also used to assess the performance of each scenario in meeting the Reliable Runways goal. This measure is intended to capture the worst delay conditions that passengers would typically encounter in terms of schedule disruptions. The threshold level for this measure was set at 20 minutes, approximately 33 percent higher than the 15-minute threshold for average delay, because these delays are naturally longer than the average delay for all hours and a different metric is warranted.

In the Baseline forecast, the average peak 3-hour delay at SFO increases from 7.7 minutes in 2007 to 27.5 minutes in 2035, well above the threshold level. As shown in Exhibit 4-5, the average peak 3-hour delay falls to 10.5 and 8.5 minutes in Scenarios A and B, respectively. Scenarios A and B reduce the peak 3-hour delay to well below the 19.4 minutes that would occur if the region solely relied on market forces to redistribute passenger traffic among the airports, as in the Traffic Redistribution Scenario.

Exhibit 4-5: Peak 3-Hour Aircraft Delays at SFO, by Scenario



4.3 HEALTHY ECONOMY

In the competitive global economy, maintaining quality and efficient airline access to the Bay Area is essential. Excessive aircraft delays can hinder regional economic growth by discouraging global commerce and as well as business and visitor travel, which inject revenue into the local economy and stimulate economic growth. Unacceptable delays at SFO in the late 1990s have been linked to a downturn in the region's convention bookings and tourism during that period. Thus, average aircraft delay is used as a proxy to assess each scenario's ability to promote a healthy economy for the Bay Area.

Exhibit 4-6 summarizes the performance of each scenario in meeting the healthy economy goal based on average aircraft delay at SFO. All of the final scenarios, including Scenario C, are rated High because SFO's average aircraft delay for each scenario falls below the delay threshold of 12 to 15 minutes. Traffic Redistribution alone, without any other interventions to reduce delays is rated medium, because average delay in that scenario is 15 minutes, at the upper boundary of the delay threshold.

Exhibit 4-6: Healthy Economy and Average Delays at SFO, by Scenario

Scenario	2035 SFO Avg Aircraft Delay (minutes)	Healthy Economy Rating
Baseline	21	Low
Redistribution	15	Medium
Scenario A	8	High
Scenario A + HSR	6	High
Scenario B	7	High
Scenario B + HSR	5	High
Scenario C	10	High

4.4 GOOD PASSENGER SERVICE

Improving transportation access between the Bay Area and the region's major air travel markets is another important goal of the study. Each of the final scenarios was evaluated in terms of their relative level of transportation services to the region's top air travel markets. The performance metric for this goal was defined as annual aircraft departures per capita in the Bay Area's top 15 domestic origin-destination (O&D) markets. Because Scenarios A and B were considered with and without the implementation of High-Speed Rail in the California corridor, train frequencies are counted as flights for the scenarios that include High-Speed Train service. Exhibit 4-7 shows the region's top O&D markets in 2035.

Exhibit 4-7: Top 15 Domestic O&D Passengers Markets for the Bay Area Region, *Base Case 2035*

Rank	Market	2035 O&D Passengers	Percent of Total
1	New York	4,349,120	6.9%
2	Los Angeles	4,178,694	6.6%
3	Las Vegas	3,986,539	6.3%
4	Seattle	3,724,052	5.9%
5	San Diego	3,557,524	5.6%
6	Orange County	2,469,276	3.9%
7	Portland	2,460,057	3.9%
8	Chicago	2,436,467	3.8%
9	Denver	2,238,593	3.5%
10	Phoenix	1,998,001	3.1%
11	Burbank	1,823,320	2.9%
12	Washington, DC	1,782,370	2.8%
13	Boston	1,745,787	2.7%
14	Dallas/Ft. Worth	1,434,236	2.3%
15	Salt Lake City	1,367,780	2.2%
	Subtotal	39,551,817	62.3%
	All Other	23,932,453	37.7%
	Total	63,484,270	100.0%

In the Baseline forecast, per capita air service in the top O&D markets is virtually flat between 2007 and 2035 at 263 and 262 annual departures per 10,000 persons, respectively. (See Exhibit 4-8) The service measure is virtually unchanged because growth in departures in the top 15 O&D markets is projected to keep pace with the projected growth in Bay Area population. The scenarios that include High-Speed Rail

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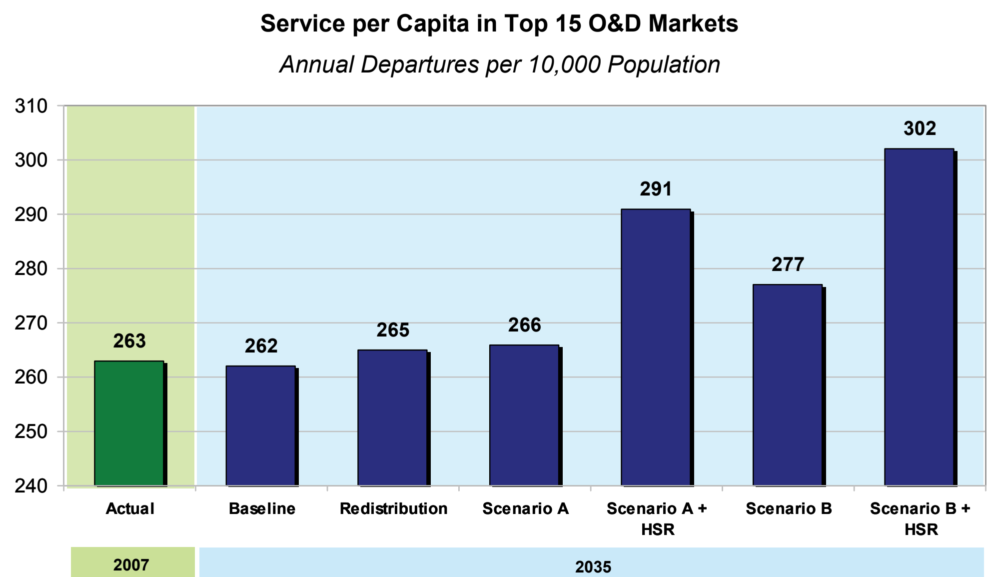
produce the highest level of service at 291 departures per 10,000 persons for Scenario A plus HSR and 302 for Scenario B plus HSR. Even though aircraft operations are reduced with train substitution, there is a net increase in service in these scenarios, because of the high–frequency of the proposed High-Speed Rail services.

Scenario B without High-Speed Rail service is the second best scenario with a projected 277 departures per 10,000 persons. Scenario A which includes demand management is only slightly better than Traffic Redistribution on the good passenger service metric.

Exhibit 4-8: Flight Frequency per Capita in Top 15 Domestic O&D Markets, by Scenario



Note: Service includes high-speed train frequencies. 2035 population is based on ABAG's 2007 Projections for the nine-county Bay Area region.

4.5 Convenient Airports

The Convenient Airports goal evaluates the ability of each scenario to maintain or improve ground access conditions for air passengers traveling to and from the primary airports.. The two main metrics used to assess scenario performance for this goal are: (1) average ground time for air passengers accessing the airports and (2) the average ground access distance for air passengers traveling to the airports (travel cost was also evaluated but is not discussed here as the results generally are the same as access time and distance in terms of Scenario performance). The analysis is based on an assessment of where air passenger trips are forecast to originate in the Bay Area (i.e., by regional travel analysis zones) and which airports/HSR stations they use in the various Scenarios. Then these air passenger trips are divided by ground transportation mode based on patterns from the latest MTC air passenger surveys at the three airports The MTC regional travel analysis modeling system was used to determine highway travel times and air passenger vehicle miles traveled (VMT) for 2035. Travel times and distances to planned High-Speed Rail stations are included in the results for scenarios that assume High-speed rail implementation. The scenario results for each measure are discussed below.

4.5.1 Ground Access Time

The average air passenger ground access time for the 2035 Base Case is 50.6 minutes, compared to 48.4 minutes in the 2007 base year, due largely to projected increases in congestion on the region's streets and highways.[3] (Exhibit 4-9) All of the scenarios result in average ground access times that are slightly lower than the 2035 Base Case and the Traffic Redistribution Scenario. In general, with traffic redistribution and higher levels of air service at OAK and SJC, more passengers are able to utilize airports closer to their ground origins. High-Speed Rail further lowers average passenger access times as the planned rail stations are more centrally located to many air passenger ground origins than the airports. Of all the scenarios, Scenario B with High-Speed Rail results in the greatest reduction in access time relative to the Baseline. In addition to more extensive air passenger redistribution than the A scenarios, it includes greater utilization of Sonoma County Airport by passengers who are closer to that airport than one of the primary airports.

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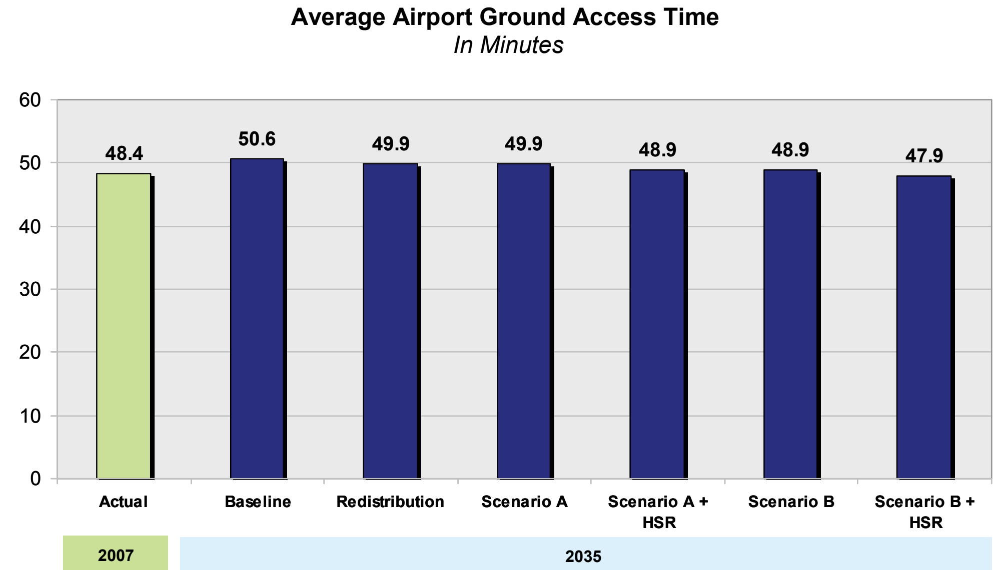
[3] Average ground access times reported in the Mid-Point Screening were revised slightly as a result of refinements to the methodology. Previous estimates were 50.0 for the 2035 Baseline and 49.7 for the Redistribution Scenario.

Exhibit 4-9: Average Passenger Ground Access Times, by Scenario

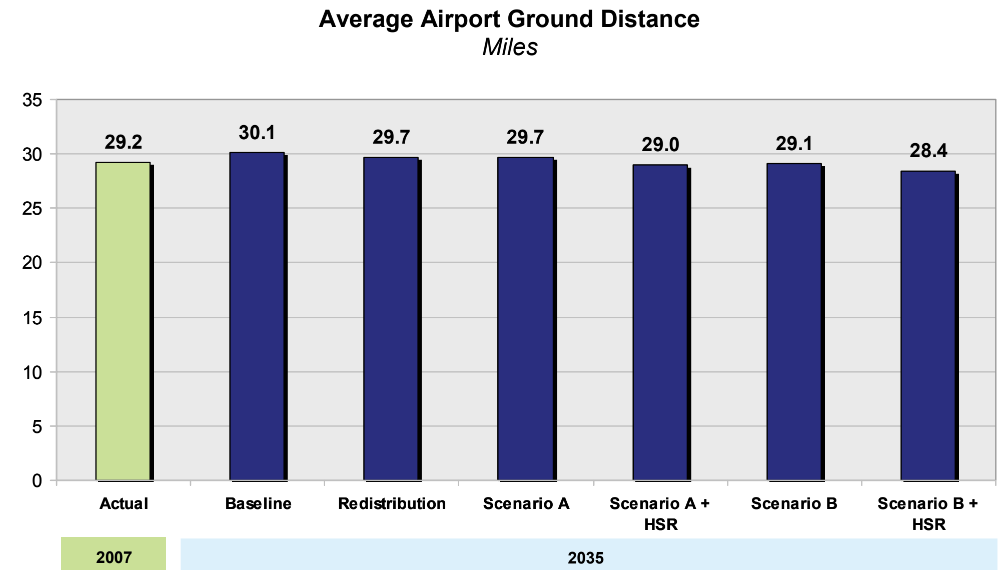


Note: Baseline and Redistribution times reflect slight revisions to the values reported for the Mid-Point screening analysis. Scenario B includes average access times to Sonoma County Airport; Scenarios with HSR include average access times to rail stations.

4.5.2 Ground Access Distance

The average ground distance for passengers traveling to the primary airports in the 2035 Baseline is 30.1 miles, up slightly from the 2007 base year distance of 29.2 miles. (Exhibit 4-10) As with average ground access times, all of the final scenarios result in slightly lower average ground distances than the Baseline and the Traffic Redistribution scenarios. Scenario B with High-Speed Rail has the lowest average distance at 28.4 miles, because a portion of the forecast Bay Area passengers are assumed to use the closer Sonoma County Airport or High-Speed Rail, which has more conveniently located train stations.

Exhibit 4-10: Average Passenger Ground Access Distance, by Scenario



Note: Baseline and Redistribution distances reflect slight revisions to the values reported for the Mid-Point screening analysis. Scenario B includes average access distance to Sonoma County Airport; Scenarios with HSR include average access distance to rail stations.

4.6 Climate Protection

The climate protection goal evaluates greenhouse gas (GHG) emissions from aircraft and air passenger vehicle trips to and from the airports. A number of local, state and national efforts are underway to control growth in GHGs. The performance metric for the climate protection goal is daily tons of carbon dioxide (CO_2) produced by aircraft and air passenger vehicle trips.

Aircraft emissions, including emissions from ground support equipment (GSE)[4] and aircraft auxiliary power units, were developed as described in the *Mid-Point Screening Report* using the latest version of FAA's EDMS 5.1.1 modeling tool. Future year aircraft emissions reflect projected aircraft delays and improvements in the fuel efficiency of the aircraft fleet. Emissions from secondary airports in the Bay Area region are excluded except for the incremental emissions associated with additional air services at Sonoma County Airport in the B scenarios.

Ground vehicle emissions are based on projections of ground access and egress vehicle trips by mode between each regional travel analysis zone, including the

[4] GHG emissions from GSE are included in the base year 2007 analysis. In 2035 all GSE are assumed to be electrified resulting in no on-airport GHGs from GSE.

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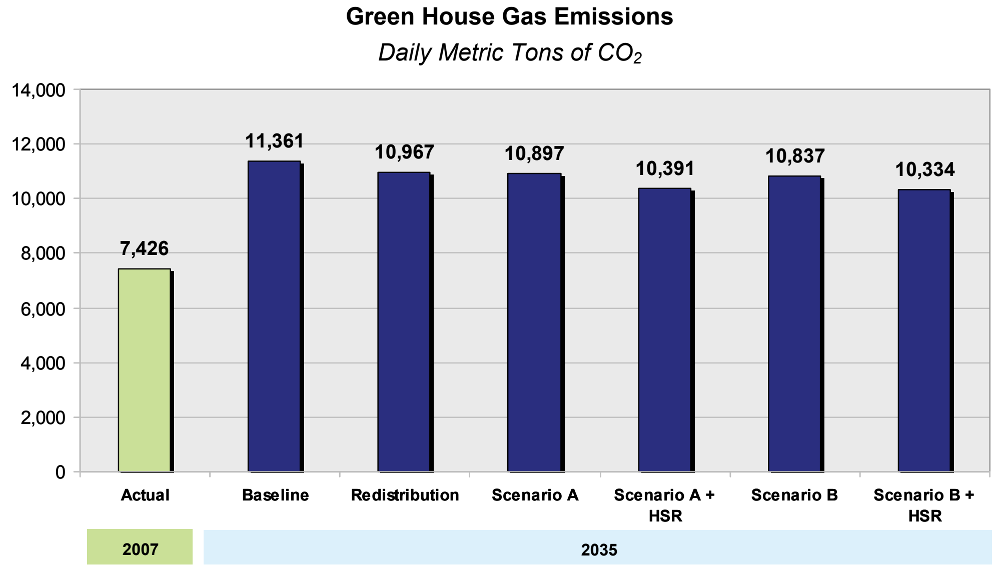
external zones, and each Bay Area airport. Scenarios that assume High-Speed Rail implementation include emissions from air passenger vehicle trips to the rail stations. CO_2 emission rates per vehicle-mile were provided by MTC staff based on average vehicle emission rates for the Bay Area vehicle fleet calculated using the California Air Resources Board EMFAC model. These assumptions reflect the increasing fuel efficiency of the automobile fleet as mandated by the latest federal standards.

GHG emissions from High-Speed Rail trains are excluded from the High-Speed Rail Scenario since the majority of forecast HSR riders are riders that are diverted from cars as opposed to diverted airline passengers. However, as described in the *Mid-Point Screening Report,* a comparative analysis shows that the aircraft at SFO (based on the average of the most and least fuel efficient aircraft) emit three to six times as many GHGs per passenger mile as High-Speed Rail trains under different HSR electric energy source and travel speed assumptions. Based on this comparative analysis, diversion of air passengers to High-Speed Rail is expected to result in a net reduction in GHGs.

Exhibit 4-11 summarizes the GHG emissions by scenario. Total GHG emissions from aircraft sources and ground access vehicles are projected to increase significantly, by 53 percent, from 7,426 metric tons per day in 2007 to 11,361 per day in the 2035 Baseline. While some improvements in aircraft fuel efficiency is expected over the forecast period, the increase in aircraft operations is expected to offset any fuel efficiency gains. All of the scenarios result in lower GHG emissions than the 2035 Baseline. Scenarios A and B reduce GHGs by 4 and 5 percent, respectively. If High-Speed Rail were implemented along with Scenarios A and B, GHG reduction would increase to approximately 9 percent, excluding emissions from the train operations.

Exhibit 4-11: Green House Gas Emissions, by Scenario



Notes: Includes emissions from aircraft and airport ground access vehicles.
Scenario B includes emissions from additional air services at Sonoma County Airport.
Scenarios with HSR exclude emissions for rail service.

4.7 AIR QUALITY

The clean air goal evaluates the impact of the scenarios on air pollution from aircraft operations and passenger vehicle trips to and from the airports. The performance measure for the Clean Air goal includes the daily tons of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) produced by aircraft and ground access vehicles. These two pollutants negatively affect air quality by combining in the presence of sunlight to create ground level ozone, a major component of smog.

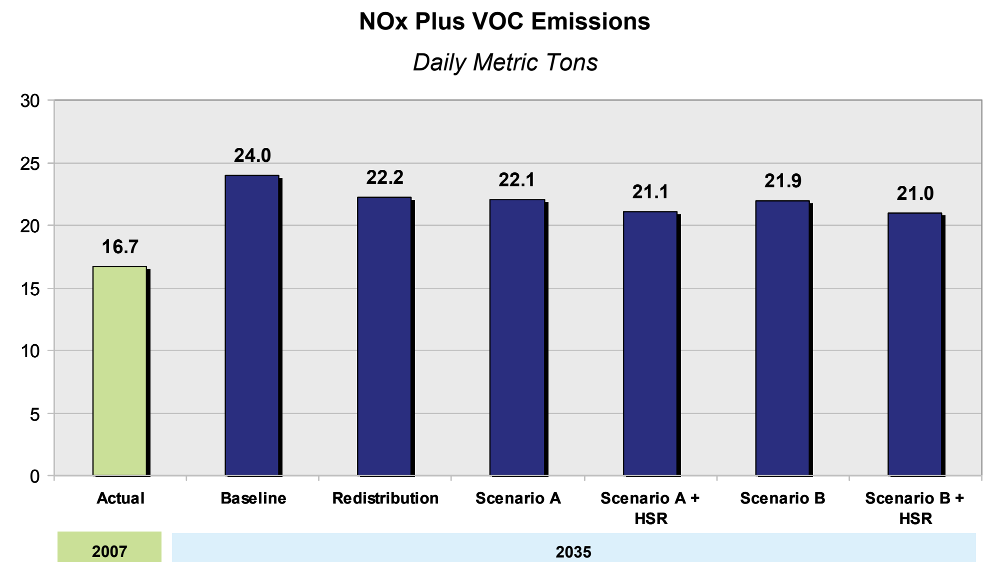
The emissions for these criteria pollutants were modeled similarly to the GHG emissions with one exception. The GHG emissions were modeled out to a 40 nm horizontal radius, while the emissions for the criteria pollutants were modeled for the phases of flight up to an altitude of 2,300 feet.

For the 2035 Baseline, aircraft and ground access vehicles emit 23.9 tons of VOCs and NO_x per day, an increase of 43 percent over the 2007 base year emissions.[5] (See Exhibit 4-12) Similar to the GHG emissions, the projected increase in aircraft operations offsets any reduction in emissions from improvements in the fuel

[5] In the 2035 Baseline, aircraft account for 97 percent of NOx and VOC emissions and passenger ground access vehicles account for 3 percent.

efficiency of aircraft and ground vehicles. Scenarios A and B reduce air pollutant emissions by eight to nine percent. The combination of Scenario B and High-Speed Rail results in the lowest level of VOC and NO_x emissions at 21 daily tons, a reduction of 12.5 percent over the Baseline emissions level, due to the reduction in aircraft operations that results from air passenger diversion to HSR.

Exhibit 4-12: NO_x and VOC Emissions, by Scenario



Note: Includes emissions from aircraft and airport ground access vehicles.
Scenario B includes emissions from additional air services at Sonoma County Airport.
Scenarios with HSR exclude emissions for rail service.

4.8 Noise

The Liveable Communities goal addresses aircraft noise exposure in the communities surrounding the airports. Two metrics were used to assess the impact of the scenarios on noise exposure: (1) the population within the 65 decibel (dB) Community Noise Equivalent Level (CNEL) contour, and (2) the population within the 55 dB CNEL contour, a larger noise exposure area which is also a source of community noise concerns. The 2007 airport noise contours are based on actual data provided by the airports. The impacted areas for the 2035 Baseline and scenario contours were estimated using the Federal Aviation Administration's (FAA) Area Equivalent Method (AEM) as described in the *Mid-Point Screening Report*.

The 2007 base year and 2035 populations are based on data and estimates provided by the Association of Bay Area Governments (ABAG, *Projections 2007*). ABAG's

2035 projections assume more growth in the central core of the Bay Area and in Priority Development Areas next to transit services. Thus, compared to 2007, these policy projections will result in additional numbers of residents being affected by airport noise when Priority Development Areas are near airports. To distinguish changes in the contour population counts due to forecast changes in residential population from changes due to growth in the size of the noise contour itself (due to increased aircraft noise), the analysis for each scenario shows what the impact would be if the 2007 population in each census tract remained the same in 2035, as well as the impact if the population changed according to ABAG's policy forecasts.

Changes in the area of the noise contours primarily reflect increases or decreases in aircraft operations and changes in aircraft fleet mix. Even though changes in aircraft types are considered in the future year fleets, the increase in operations is greater than any benefits resulting from improvements in the noise characteristics of the airline fleet largely because the noisiest aircraft have already been retired from airline fleets. The area of the contours is also affected by changes in the hourly timing of aircraft flights. The future year cases incorporate projected aircraft delays and their effect on the timing of aircraft operations. For example, with forecast growth in flights at SFO and the resulting capacity problems, flights scheduled during the daytime period (7 a.m. to 7 p.m.) may be delayed into the more noise sensitive evening period (7 p.m. to 10 p.m.) and evening flights may be delayed into the most noise sensitive nighttime period (10 p.m. to 7 a.m.).[6]

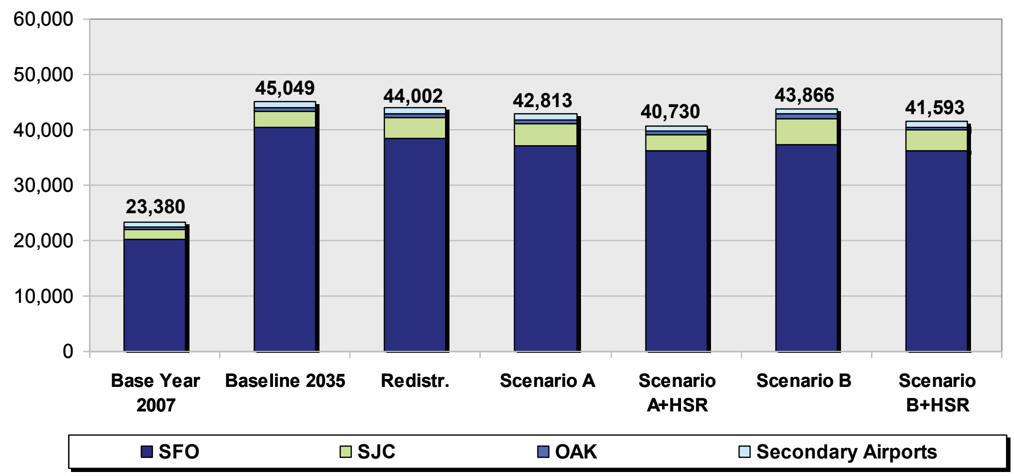
4.8.1 Population within 65 CNEL

Exhibit 4-13 summarizes the populations within the 65 CNEL contour for the 2007 base year, the 2035 Baseline and the 2035 scenarios using 2007 population data. As shown, the population exposed to 65 CNEL nearly doubles from 23,380 in the 2007 base year to 45,049 in the 2035 Baseline. These population estimates include all people residing in the area covered by the noise contour and may include population residing in residences that have been sound insulated through airport and FAA sponsored mitigation programs. These sound insulated residences would be considered "noise compatible" under California's airport noise standards.

[6] In determining CNEL, it is assumed that the aircraft noise emissions occurring at night (10 p.m. to 7 a.m.) are 10 dB louder than they really are. This 10 dB penalty is applied to account for greater sensitivity to nighttime noise, and the fact that events at night are often perceived to be more intrusive because nighttime ambient noise is less than daytime ambient noise. A lesser penalty is applied to evening noise levels (7 p.m. to 10 p.m.). The evening penalty is approximately 4.77 dB and likewise accounts for the greater sensitivity to noise in the evening.

The noise exposed populations for all of the final scenarios are lower than the population counts for the 2035 Baseline and the Traffic Redistribution Scenario. Scenario A with HSR produces the lowest 65 CNEL population at 40,730. The noise contour for Scenario B has a slightly higher population than the Scenario A contour, primarily because more passengers are shifted to the OAK and SJC airports and the noise contours encompass additional residential population (mainly for SJC). As with SFO, some of these homes may already have received sound insulation.

Exhibit 4-13: Population in 65 CNEL, by Scenario *(using 2007 Population counts)*

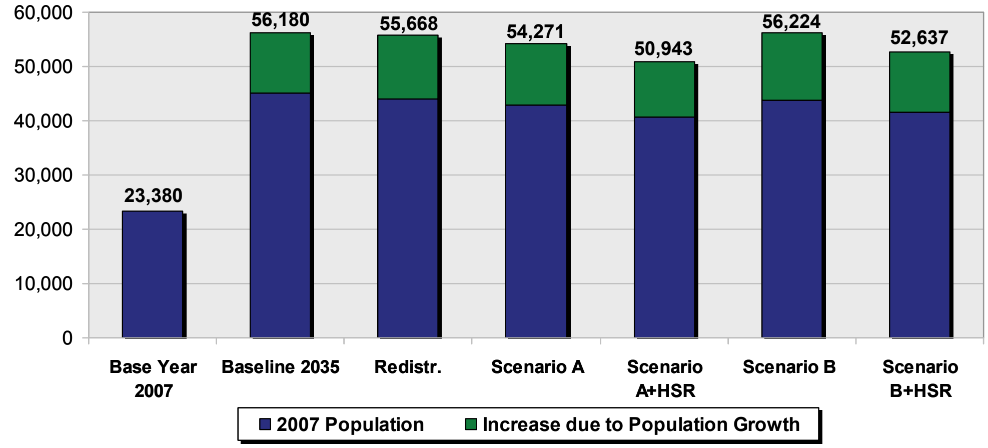


Notes: Change in population from 2007 Base year to 2035 Baseline results from forecast growth in aircraft operations.
Secondary airports include Sonoma County Airport, Buchanan Air Field, and Travis AFB.
Some residences in forecast 2035 contours have already been soundproofed.

The SFO contour accounts for 86 percent of the combined 65 CNEL population in the 2007 base year. The SFO share increases to 90 percent in the 2035 Baseline and ranges from 85 percent (Scenario B) to 89 percent (Scenario A + HSR) for the final scenario cases.

Exhibit 4-14 shows the future year 65 CNEL populations using ABAG's population forecast data. Using ABAG's policy projections to evaluate the residential population impacts produces higher noise-exposed population numbers than the analysis based on 2007 population. The combined 65 CNEL population for the Bay Area airports more than doubles from 23,380 in 2007 to 56,180 in 2035 when the analysis is done with the ABAG policy projections. Of the total increase in population between 2007 and the 2035 Baseline, approximately 64 percent is due to the growth in aircraft operations. The remaining 34 percent of the increase is due to population growth in the areas around airports that is assumed in the region's policies for developing more sustainable growth patterns over the long term.

Exhibit 4-14: Population in 65 CNEL, by Scenario *(using 2035 Population Forecast)*



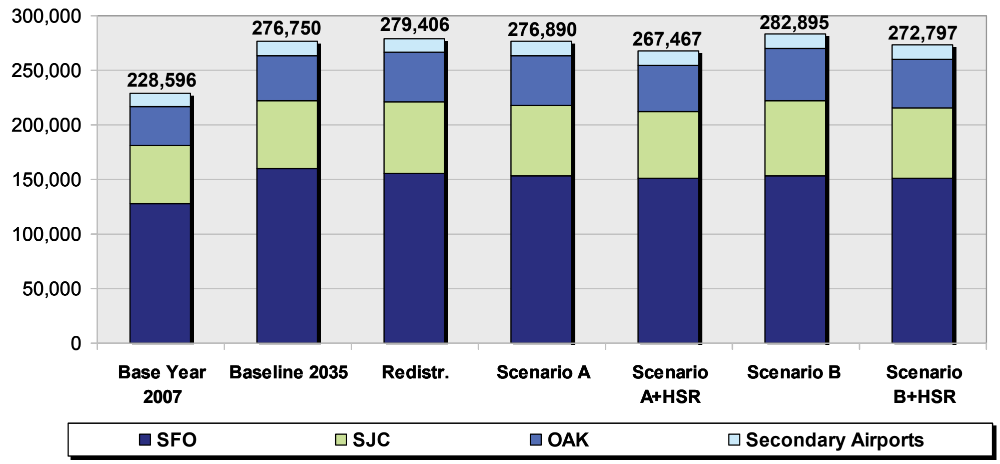
Notes: Change in population from 2007 Base year to 2035 Baseline results from growth in aircraft operations and population.
Some residences in forecast 2035 contours have already been soundproofed.

4.8.2 Population within 55 CNEL

The population within the 55 CNEL was also used to evaluate the scenarios against the Liveable Communities goal, given the potential for noise complaints from residents living in these areas. The 55 CNEL contours cover a larger area than the 65 CNEL contours and thus include a significantly larger population. The 2007 base year population count for the 55 CNEL is 228,596 compared to 23,380 for the 65 CNEL. Exhibit 4-15 shows the 55 CNEL populations for the base year and the future year cases based on 2007 population counts. The combined 55 CNEL population for the Bay Area airports increases by 21 percent between 2007 and the 2035 Baseline.

Scenario A with HSR produces the lowest number of people in the 55 CNEL contour at 267,467, which is 3.4 percent lower than the 2035 Baseline. All of the scenarios without HSR, including Traffic Redistribution from the Mid-Point Screening analysis, result in more population than the Baseline primarily because the increases in activity and noise exposure at OAK and SJC more than off-set reductions at SFO.

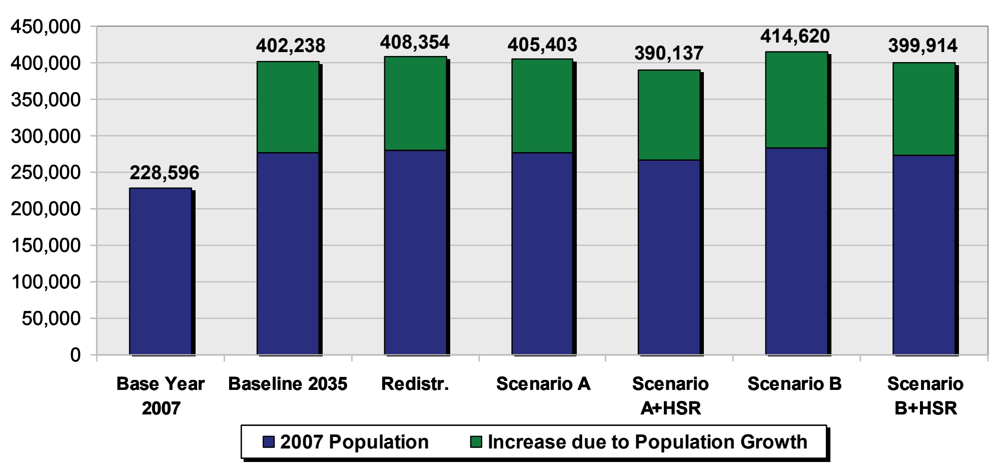
Exhibit 4-15: Population in 55 CNEL, by Scenario *(using 2007 Population counts)*



Notes: Change in population from 2007 Base year to 2035 Baseline results from forecast growth in aircraft operations.
Some residences in forecast 2035 contours have already been soundproof

The effect of ABAG's policy population projections on the 55 CNEL is shown in Exhibit 4-16. If ABAG's population increases for areas around airports are taken into account, the combined 55 CNEL population would increase by 76 percent from 228,596 in 2007 to 402,238 in 2035. With these policy projections 72 percent of the population increase between 2007 and the 2035 Baseline would be from population added by ABAG's policy projections, and 28% would be from growth in aircraft operations.

Exhibit 4-16: Population in 55 CNEL, by Scenario *(using 2035 Population Forecast)*



Notes: Change in population from 2007 Base year to 2035 Baseline results from growth in aircraft operations and population.
Some residences in forecast 2035 contours have already been soundproofed.

5 FINAL SCENARIO COMPARISONS

5.1 INTRODUCTION AND SPECIAL CONSIDERATIONS

This section summarizes the results of the final scenario analysis and compares the performance of each scenario to the 2035 baseline and to each other. The final scenario analysis provides important information on how various strategies, other than runway expansion, can help address the region's airport capacity needs and environmental goals.. The results of this analysis will inform the Vision and Implementation Plan that will serve as a guide for future airport planning decisions.

The analyses presented in this report are estimates of what each scenario might be able to achieve relative to the various study goals. While there are a number of uncertainties involved in this type of assessment, reasonable assumptions were made to assess the potential of each Scenario. The assumptions are based in part on the expert judgment of the study team, but also on the guidance, input and review of several expert panels. Nevertheless, there is uncertainty that surrounds elements of the final scenarios as described below.

5.1.1 Traffic Redistribution and Use of Secondary Airports

There is a high degree of uncertainty associated with how rising delays at SFO will affect airline service decisions as assumed in Scenario A and Scenario B, including the use of secondary airports (i.e., Sonoma County in Scenario B). There is also uncertainty as to how air passengers will respond to new airline services with regard to fare competition and flight frequencies offered. Despite these uncertainties, it is reasonable to assume that in an environment with excessive delays at SFO, passengers may respond by opting to use the less congested airports and that severe congestion at SFO may promote faster service development at OAK and SJC.

Regarding the use of secondary airports, the current airline operating environment has caused airlines to eliminate or downscale their services at smaller secondary airports. If airlines were to add additional services at secondary airports in the future, the ultimate success of those services would hinge on passenger acceptance of the airports and their service offerings as practical alternatives to the primary Bay Area airports. However, Sonoma County Airport, which is the only airport included in the final scenarios (Scenario B), currently receives commercial airline services, and it is reasonable to assume that airlines would increase services there in the face of severe congestion and delays at SFO in the future.

5.1.2 Air Traffic Control Technologies

There is much uncertainty surrounding the timing and ultimate implementation of many of the NexGen ATC technologies that were analyzed in the original set of Scenarios.. Whether or not the Air Traffic Control technologies analyzed are fully developed and deployed depends on many factors outside the direct control of RAPC such as funding, aircraft equipage rates, and airline and air traffic controller acceptance. However, based on input from the airports and the expert panel on ATC improvements, only a modest set of ATC improvements was included in the final scenarios.

5.1.3 High-Speed Rail

The High-Speed Rail Scenario is subject to several uncertainties mainly relating to funding, the timing of implementation, service levels, fares, and a potential competitive response from airlines. For this reason, Scenarios A and B were analyzed with and without High-Speed Rail. The analysis of High-Speed Rail and its impact on air travel in the region were based on the latest ridership projections from the California High-Speed Rail Authority (CHSRA). These projections, however, are subject to change from time to time as assumptions are revised and new information becomes available.

5.1.4 Demand Management

The final scenarios also assume varying degrees of demand management at SFO. The potential effectiveness of demand management policies is uncertain as there is only limited U.S. airport experience with demand management programs. Administrative measures such as perimeter rules that limit airline flights to those within a certain radius of the airport are in place at New York La Guardia and Washington Reagan National, but these pre-date the 1990 Airport Noise and Capacity Act (ANCA) and are grandfathered restrictions.

In 1969, federal legislation imposed slot controls on several "high density" U.S. airports: New York LaGuardia, New York JFK, Newark, Washington Reagan National, and Chicago O'Hare. The rule was suspended at Newark in 1970 and in recent years the slot controls at the other New York airports and Washington Reagan have been relaxed. Through Air-21 legislation enacted in 2000, slots at O'Hare Airport were entirely phased out by July 1, 2002. However American and United significantly increased operations at O'Hare in 2004. FAA stepped in and through negotiations the carriers voluntarily reduced aircraft operations. Similar flight caps have been imposed by the FAA at the LaGuardia, Newark and JFK airports.

Boston Logan International Airport is the only U.S. airport with a demand management program based on differential pricing. The program at Logan is a pre-emptive program designed to alert airlines when the level of airline scheduling could result in average delays for three consecutive hours exceeding 15 minutes per operation. At that delay threshold, a surcharge of $150 per flight would be assessed to airlines operating during congested periods. The design of the program allows airlines to avoid incurring additional fees by voluntarily rescheduling or reducing operations at the airport.

The ultimate form of demand management at SFO and its effectiveness would be determined by the airport operator and would be subject to review and approval by the U.S. DOT. The assumptions underlying the Demand Management Scenario are both comprehensive and aggressive, and future programs may or may not be as effective as assumed in this study. Nevertheless, the analysis performed is useful in that it provides a benchmark for what a strong demand management approach might accomplish in terms of reducing delays at SFO.

5.2 Final Scenario Analysis Results

A comparison of each scenario's performance relative to the study goals is presented as a stop-light matrix in Exhibit 5-1. The goals can be divided into four types: (1) aircraft delays (i.e., Healthy Economy and Reliable Runways); (2) effective transportation options (i.e., Good Passenger Service); (3) passenger ground access (i.e., Convenient Airports); and (4) environmental goals (i.e., Climate Protection, Clean Air and Livable Communities).

For an individual goal, a green box indicates that the scenario achieved "High" results, whereas a yellow box indicates a "Medium" impact and a red box denotes a "Low" impact. Percentage wise, Scenario results for the delay related goals were significantly greater than the results for the other goals. Therefore two different scales are used to measure scenario performance. For the delay goals, a High performing scenario achieves delay reduction of 50 percent or greater; Medium performance is defined as a 15-49 percent delay reduction; and a Low performing scenario produces less than a 15 percent reduction in average delays. For the remaining goals, a High performing scenario produces a benefit of at least 10 percent. A scenario is ranked Medium if it produces a benefit of five to nine percent. A Low scenario produces a benefit of less than five percent.

5.2.1 Healthy Economy and Reliable Runways

The first two goals, Healthy Economy and Reliable Runways, are both measured in terms of average aircraft delays at SFO. While most of the original Scenarios analyzed in isolation were not effective at reducing delays below the delay threshold, the combination of strategies in Scenarios A and B produce significant benefits with delay reduction in excess of 50 percent. All of the final scenarios are effective at reducing SFO delays to below the 12 to 15-minute threshold.

Exhibit 5-1: Comparison of Screening Analysis Results by Alternative

Scenario:	Goal: Economy	Reliable Runways	Good Service	Convenient Airports	Climate Protection	Clean Air	Livable Communities
Metric:	*Average Aircraft Delay*	*Average Aircraft Delay*	*Flight Frequency in Top 15 O&D Markets*	*Average Ground Access Time*	*Green House Gases (CO2)*	*Hydrocarbons (Nox+VOCs)*	*Population in 65 CNEL*
Scenario A	-61.4%	-61.4%	1.4%	-1.5%	-4.2%	-7.8%	-5.1%
Scenario A+HSR	-69.8%	-69.8%	11.0%	-3.3%	-8.7%	-11.9%	-9.8%
Scenario B	-68.2%	-68.2%	5.6%	-3.5%	-4.8%	-8.4%	-2.7%
Scenario B+HSR	-74.8%	-74.8%	15.2%	-5.3%	-9.2%	-12.5%	-7.9%

Impact vs. Baseline	Improvement Criteria: Aircraft Delay	Improvement Criteria: All Other
High Impact	>= 50%	>= 10%
Medium Impact	15 to 49%	5 to 9%
Low Impact	< 15%	< 5 %

Notes: Climate Protection, Clean Air and Livable Communities exclude impacts of trains in High-Speed Rail Scenario

By lowering SFO's average aircraft delays to acceptable levels, all of the final scenarios are also effective in supporting a healthy and growing economy for the Bay Area region.

5.2.2 Good Passenger Service

In the Mid-Point Screening analysis, the High-Speed Rail Scenario was the only scenario that rated High in terms of the Good Passenger Service goal, which measures the change in "service frequencies" in the region's top 15 domestic O&D air passenger markets. Similarly, in the final scenario analysis, the scenarios that include High-Speed Rail produce the greatest increase in the Good Passenger Service metric and are rated as High performers. This is due in large part to the proposed high frequency of the train service between the Bay Area and Southern California. Scenario A ranks Low and Scenario B is slightly better with a Medium ranking because of the introduction of new airline services at Sonoma County and because the shift in air passenger demand to OAK and SJC leads to an increase in service frequencies since the average aircraft size at these airports is lower than the average aircraft size at SFO.

5.2.3 Convenient Airports

Results for the Convenient Airports goal are summarized in terms of the average airport ground access time, although the results would be similar for the average airports ground access distance measure. Most of the scenarios rank as Low performers, as they have little impact on the average travel time it takes an air passenger in the Bay Area to reach an airport or HSR station. Scenario B with High-Speed Rail is slightly better with a Medium rating. The combination of greater use of Sonoma County Airport and High-Speed Rail reduces average ground access time by 5.3 percent.

5.2.4 Climate Protection

The Scenarios with High-Speed Rail perform the best in terms of the Climate Protection goal with a Medium rating. With HSR service in the California Corridor, GHGs (measured as CO_2 emissions) decline by approximately 9 percent, compared to 4-5 percent for the scenarios without High-Speed Rail. The analysis of GHG emissions does not consider emissions from the power sources used to propel the high-speed trains; however, a sensitivity analysis of GHG emissions per passenger mile indicates that a net reduction in GHG is likely to occur compared to making the same trip by air.

5.2.5 Clean Air

The scenarios with High-Speed Rail also produce the greatest reduction in aircraft and air passenger ground vehicle emissions (measured as total hydrocarbons and nitrogen oxides – precursors for ozone). The reductions are in excess of 10 percent, thus these scenarios rank as a High performing scenario for the Clean Air goal.

5.2.6 Livable Communities

The results for the Livable Communities goal are based on the 65 CNEL population analyses using 2007 population data to assess future changes in airport noise exposure under each Scenario. High-Speed Rail produced the greatest reduction in aircraft operations and thus was the highest performing scenario among the six original Scenarios. For the same reasons, the final scenarios that include High-Speed Rail produce the greatest reduction in the noise-exposed population. The combined 65 CNEL population for the three airports declines by 9.8 percent in Scenario A with HSR and by 7.9 percent in Scenario B with HSR, resulting in a Medium rating for both scenarios. The scenarios without HSR are rated Low performers for the Livable Communities goal.

5.3 Conclusion

From a capacity standpoint, the final scenario analysis indicates that all the Bay Area airports could function without excessive delays under Scenario A (market driven traffic redistribution) or Scenario B (market and demand-management driven traffic redistribution). Of course these Scenarios also benefit from ATC improvements and comprehensive demand management approaches as well. The implementation of a California High-Speed Rail system, as in Scenarios A + HSR and Scenario B + HSR, would further reduce SFO's average aircraft delays and provide greater environmental benefits. There is, however, some uncertainty in the various implementation aspects of these Scenarios, as discussed above, which require special attention and monitoring in order to assess their effect on these conclusions.

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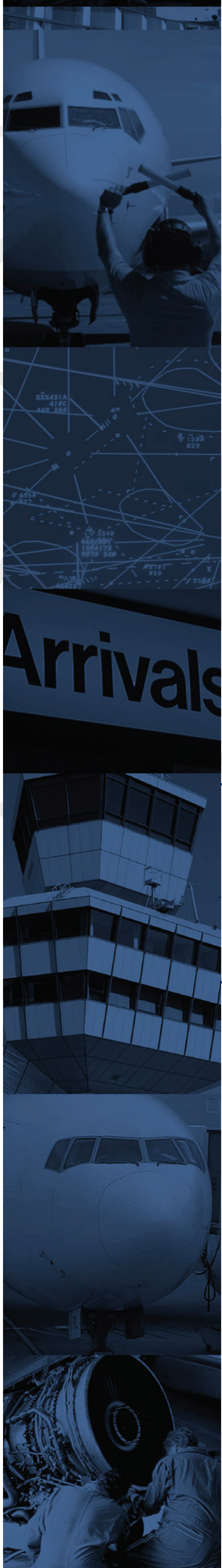

Appendix A:

Technical Memo – Bay Area Airports Emission Inventory for Scenarios A and B in 2035

Bay Area Airports Emission Inventory for Scenario A and B in 2035

Technical Memo

Prepared for San Francisco Bay Area Metropolitan Transportation Commission

September 2010

Target Analysis Scenarios A and B

This technical memo builds upon the earlier report ”Bay Area Airports Emission Inventory for Base Year (2007) and Target Analysis Scenarios in 2035”, August, 2010 which evaluated the emission impacts for each of the major airports (San Francisco International (SFO), Oakland International (OAK), and Norman Y. Mineta San Jose International (SJC)) for six target analysis scenario and for the current and future baseline scenarios. In this report we evaluate two hybrid scenarios for 2035 using projected estimates of aircraft operations and taxi delay by combining various sub-elements from the six target analysis scenarios as discussed in the earlier report.

The same approach in estimating emissions as used in the earlier study was used in this analysis. Airport emission estimates were made for PM_{10}, $PM_{2.5}$, NO_x, SO_2, volatile organic compounds (VOC), CO, CO_2, N_2O, CH_4, and total greenhouse gases (GHG)[1] as CO_2-equivalent[2]. Again, it was assumed that by 2035 all ground support equipment (GSE) at the three Bay Area Airports will be electrified resulting in no on-airport emissions from GSE.

In the next section we briefly summarize the methodological used in developing the emission inventory for each of the scenarios evaluated in this report. The reader is referred to the earlier report for a more in-depth discussion on methodology followed in developing the airport emission inventory. Model results are then presented with discussion about the findings for each scenario.

Summary of Emission Inventory Development

The general approach in developing the Bay Area Aircraft Emission Inventory was to develop an airport specific emission inventory for each of the three major airports in the region (SFO, OAK, SJC) using the latest version of FAA’s EDMS 5.1.1 tool. Table S-1 summarizes the target analysis scenarios evaluated in this study. The analysis used default time in mode values as used in EDMS and for consistency with the runway capacity and delays analysis, the modeling used the runway taxi delay estimates from DELAYSIM to estimate taxi-in, taxi-out and approach times including delay. Table S-2 shows the total (impeded plus unimpeded) taxi-in, taxi-out, and total taxi times for each airport for each scenario. The unimpeded taxi-out times for SFO, OAK and SJC were 13.29, 8.92 and 9.46 minutes, respectively.

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[1] Emission factors for CH_4 and N_2O used the Airport Cooperative Research Program (ACRP) Report 11, Guidebook on Preparing Airport GHG Emission Inventories (2009) and reported as CO_2 equivalent. However, the contribution of these emissions relative to CO_2 emissions is a small (<1%) fraction of the total GHG emissions.

[2] CO_2-equilvaent is the quantity of greenhouse gases which have equivalent global warming potential as CO_2 only when measured over 100 years.

TABLE S-1. TARGET ANALYSIS SCENAROS

Case	Name	Year
Case0b	Baseline	2035
Case8	Scenario A - Modest traffic redistribution, modest demand management, no diversion to secondary airports, partial new ATC technology	2035
Case9	Scenario B - Major traffic redistribution, aggressive demand management, diversion to Sonoma County airport, new ATC technology	2035

TABLE S-2. AVERAGE TOTAL TAXI TIME FOR EACH TARGET ANALYSIS SCENARIO.

			SFO			SJC			OAK		
Case	Scenario	Year	Total (min)	Taxi-In (min)	Taxi-Out (min)	Total (min)	Taxi-In (min)	Taxi-Out (min)	Total (min)	Taxi-In (min)	Taxi-Out (min)
Case0b	Baseline	2035	35.31	4.58	30.74	13.09	3.29	9.80	16.25	5.08	11.17
Case8	Scenario A	2035	28.35	4.58	23.77	13.10	3.29	9.81	15.65	5.08	10.57
Case9	Scenario B	2035	25.86	4.58	21.28	13.24	3.29	9.95	15.85	5.08	10.77

Emissions were calculated for the five aircraft operating modes in the EDMS model: taxi-out, takeoff, climb-out, approach, and taxi-In. The sum across all modes gives the total emissions for a particular aircraft type and the sum of all emissions across all aircraft types (sizes, designation, engine type and uses) determines the total annual emissions for the airport.

Criteria pollutant emissions were calculated up to an altitude of 2,300 feet, the default annual average mixing depth in the Bay Area[3] (BAAQMD, 2004). This is also the value used by the BAAQMD in developing their inventory for Bay Area aircraft emissions. All criteria pollutant emissions were determined directly in the EDMS model. GHG emission calculations for CO_2, CH_4 and N_2O emissions were determined based on simulations similar to those for criteria pollutants with the addition that emissions were calculated out to a horizontal distance of 40 nm (radius) from each airport rather than up to a vertical height of 2,300 ft. This was done to be consistent with the approach the BAAQMD adopted in developing their GHG emission inventory.

Emissions Diverted by High Speed Rail (HSR)

For both Scenario A and B an estimate was also made on the reduction in emissions at each of the airports due to operation of a HSR system reducing the number of aircraft operations needed to support passenger service to the Southern California market. The emissions reductions used information on the specific reductions by aircraft types

[3] Steinberger, Joseph, 2004 “General Aviations Contribution to Emissions”, Senior Planner BAAQMD, March 2004 presented at the Jet Set Go, Environmental Aviation Takes Off Program, March 2004.

diverted along with operational emission profile to determine emissions. Emissions associated with the HSR operation are not included in the analysis.

Emissions Diverted to Sonoma County Airport

In Scenario B emissions from aircraft operations are diverted to the Sonoma County Airport by the same number of operations as the original Internal Regional Airports Scenario (Case 3). As a result, the number of operations at the primary airports is reduced while the Sonoma County Airport gains new services and fewer passengers travel to the primary Bay Area airports for air service. Emissions were determined at the Sonoma County Airport assuming operation of the regional jet, Bombardier CRJ-700 aircraft.

Resulting Emissions and Discussion

Predicted Emissions and Emissions Changes by Scenario

Tables S-3 through S-18 shows the predicted emissions from each of the three airports for Scenario A and B and in the percentage change relative to the 2035 baseline. Also for both Scenario A and B the reduction in emissions due to HSR diversion are also presented. These results show the reduction in emission at each airport and the percent reduction relative to Scenario A and B emissions, respectively. In addition, for Scenario B emissions are also presented for the Sonoma County Airport (STS) increased activity. These emissions represent the change in emissions above current levels – not total emissions for the airport.

The first set of tables (S-3 through S-6 for Scenario A and S-10 through S-13 for Scenario B) shows the modeled emissions along with their reduction relative to the 2035 future baseline scenario. In all cases, the relative reductions are defined as:

> Percent Relative Reduction = (value for scenario case - value for baseline case) / (value for baseline case) x 100

In examining the emission totals it should be noted that the emission rates vary substantially by operating mode particularly for NO_x and VOC. In general, jet aircraft produce substantially more NO_x than VOC (2-7 times depending upon aircraft performance characteristics) over an LTO cycle. However, most (> 70%) of the NO_x emissions occur during the takeoff and climb-out modes.

Additionally, most of the CO emissions from aircraft occur during taxi-in or taxi-out, ranging from 33% to 96% with the highest percentages occurring where taxi delay times are highest. Most of the VOC emissions occur during taxi operations ranging from a low of 60% up to 93% again with the highest percentages occurring where delays are largest. NO_x however exhibits the reverse pattern where most NO_x emissions occur during aircraft flight (77-87%). Finally, 94-96% of CO_2 emissions occur during flight.

Scenario A

For scenario A (Table S-3 and S-4), SFO criteria pollutant emissions decreased by about 11-25% depending on pollutant for aircraft and from 9 to 12 percent for auxiliary power units (APUs) with an overall decrease of about 11-25 percent. As would be expected, OAK and SJC criteria pollutant emissions increased from 2-8% for OAK and from 6-11% for SJC (Table S-4). It should also be noted that while emission increases are projected for OAK and SJC the emission decreases at SFO are substantially larger with the net result that all criteria pollutants show an overall net decrease across the Bay Area region.

GHG emissions (Tables S-5 and S-6) show an increase of about 8% at OAK and 10% at SJC, and decrease of about 12% at SFO. However the net effect for implementing Scenario A would be to reduce overall GHG emissions by about 4%.

TABLE S-3. CRITERIA POLLUTANT EMISSIONS FOR SCENARIO A (CASE 8).

			Criteria Air Pollutants					
			CO (kg)	VOC (kg)	NOx (kg)	SOx (kg)	PM-10 (kg)	PM-2.5 (kg)
2035	OAK	EDMS Aircraft	1,903,031	205,505	1,453,226	122,752	17,400	17,400
		EDMS APU	40,138	3,227	54,595	7,484	5,924	5,924
		Total	1,943,169	208,732	1,507,821	130,236	23,324	23,324
	SFO	EDMS Aircraft	4,291,548	1,330,007	3,722,303	349,180	62,072	62,072
		EDMS APU	78,705	6,203	105,856	13,722	11,899	11,899
		Total	4,370,253	1,336,211	3,828,159	362,902	73,971	73,971
	SJC	EDMS Aircraft	778,419	107,325	793,663	69,788	10,321	10,321
		EDMS APU	30,186	2,208	38,684	5,181	4,192	4,192
		Total	808,604	109,533	832,347	74,969	14,514	14,514

Table S-4. Change in Criteria Pollutant Emissions, Scenario A (Case 8) versus 2035 Baseline.

	Criteria Pollutants, 2035	CO	VOC	NOx	SOx	PM-10	PM-2.5
OAK	EDMS Aircraft	1.44%	2.84%	7.71%	6.97%	7.29%	7.29%
	EDMS APU	7.81%	8.13%	7.62%	7.99%	8.27%	8.27%
	Total	1.56%	2.92%	7.71%	7.02%	7.54%	7.54%
SFO	EDMS Aircraft	-25.15%	-24.27%	-10.67%	-17.58%	-20.09%	-20.09%
	EDMS APU	-11.75%	-9.74%	-8.59%	-8.76%	-8.74%	-8.74%
	Total	-24.95%	-24.21%	-10.61%	-17.27%	-18.46%	-18.46%
SJC	EDMS Aircraft	5.29%	7.54%	10.73%	10.42%	10.98%	10.98%
	EDMS APU	8.38%	9.09%	9.07%	8.98%	9.09%	9.09%
	Total	5.40%	7.57%	10.65%	10.32%	10.43%	10.43%

Table S-5. Greenhouse Gas Emissions for Scenario A (Case 8).

			OAK	SFO	SJC
2035	CO2 (kg)	Aircraft	789,286,740	2,049,445,826	450,663,053
		APU	10,855,293	19,903,938	7,514,692
		Total	800,142,033	2,069,349,764	458,177,745
2035	CO2e (kg)	Aircraft	797,625,065	2,074,056,064	455,359,655
		APU	10,937,890	20,055,386	7,571,870
		Total	808,562,955	2,094,111,450	462,931,525

Table s-6. Change in CO2e Emissions, Scenario A (Case 8) versus 2035 Baseline.

CO2e, 2035	OAK	SFO	SJC
Aircraft	7.64%	-11.56%	10.39%
APU	7.99%	-8.76%	8.98%
Total	7.65%	-11.53%	10.37%

Table S-7 and S-8 show that with diversion of air traffic to high speed rail that criteria pollutant emissions decrease the most at SJC ranging from an 8-12% decrease, while SFO shows the least decrease ranging from 1 to 4% decrease. This is consistent with the estimate that more SJC passengers will be diverted to HSR than SFO passengers. The largest pollutant emission decreases are seen at SJC for both NOx and particulate matter at about 12%. GHG emissions (Table S-9) also show a similar pattern of decrease in emissions of about 12% at SJC, 7% at OAK and 3% SFO.

Table S-7. Reduction in Criteria Pollutant Emissions from HSR Diversion for Scenario A (Case 8)

Criteria Pollutants, 2035		CO (kg)	VOC (kg)	NOx (kg)	SOx (kg)	PM-10 (kg)	PM-2.5 (kg)
OAK	EDMS Aircraft	65,580	9,755	98,205	8,630	1,651	1,645
SFO	EDMS Aircraft	125,634	16,508	114,634	12,755	2,327	2,320
SJC	EDMS Aircraft	68,541	10,199	100,927	8,869	1,805	1,797

Table S-8. Change in Criteria Pollutant Emissions from HSR Diversion for Scenario A (Case 8)

Criteria Pollutants, 2035		CO	VOC	NOx	SOx	PM-10	PM-2.5
OAK	EDMS Aircraft	-3.37%	-4.67%	-6.51%	-6.63%	-7.08%	-7.05%
SFO	EDMS Aircraft	-2.87%	-1.24%	-2.99%	-3.51%	-3.15%	-3.14%
SJC	EDMS Aircraft	-8.48%	-9.31%	-12.13%	-11.83%	-12.43%	-12.38%

Table S-9. Reduction in Greenhouse Gas Emissions and Percent Reduction From HSR Diversion for Scenario A (Case 8).

	Action	OAK	SFO	SJC
CO2 (kg)	Aircraft	50,837,584	64,861,442	52,652,310
	Percent Reduction	-6.46%	-3.37%	-11.58%
CO2e (kg)	Aircraft	52,233,101	70,647,528	53,609,243
	Percent Reduction	-6.46%	-3.37%	-11.58%

Scenario B (Case 9)

For scenario B (Table S-10 and S-11), SFO criteria pollutant emissions decreased by about 14-31% depending on pollutant for aircraft and from 12 to 14 percent for auxiliary power units (APUs) with an overall decrease of about 14-31 percent. As would be expected under this scenario, OAK and SJC criteria pollutant emissions increased from 4-12% for OAK and from 5-9% for SJC (Table S-11). It should also be noted that while emission increases are projected for OAK and SJC the emission decreases at SFO are substantially larger with the net result that all criteria pollutants show an overall net decrease across the Bay Area region.

GHG emissions (Tables S-12 and S-13) show an increase of about 11% at OAK and 20% at SJC, and decrease of about 15% at SFO. However the net effect for implementing Scenario B would be to reduce overall GHG emissions by about 3%.

Table S-10. Criteria Pollutant Emissions for Scenario B (Case 9).

			Criteria Air Pollutants					
			CO (kg)	VOC (kg)	NOx (kg)	SOx (kg)	PM-10 (kg)	PM-2.5 (kg)
2035	OAK	EDMS Aircraft	1,939,429	211,764	1,501,531	127,341	18,078	18,078
		EDMS APU	41,375	3,330	56,240	7,719	6,116	6,116
		Total	1,980,804	215,094	1,557,771	135,060	24,194	24,194
	SFO	EDMS Aircraft	3,953,046	1,270,883	3,593,751	323,801	58,130	58,130
		EDMS APU	76,455	5,970	100,903	13,162	11,433	11,433
		Total	4,029,501	1,276,854	3,694,654	336,963	69,564	69,564
	SJC	EDMS Aircraft	819,916	115,090	867,059	76,258	11,320	11,320
		EDMS APU	32,386	2,381	41,717	5,584	4,522	4,522
		Total	852,301	117,471	908,775	81,841	15,842	15,842

Table S-11. Change in Criteria Pollutant Emissions, Scenario B (Case 9) versus 2035 Baseline.

	Criteria Pollutants, 2035	CO	VOC	NOx	SOx	PM-10	PM-2.5
OAK	EDMS Aircraft	3.38%	5.97%	11.29%	10.96%	11.47%	11.47%
	EDMS APU	11.13%	11.58%	10.87%	11.39%	11.78%	11.78%
	Total	3.53%	6.05%	11.28%	10.99%	11.55%	11.55%
SFO	EDMS Aircraft	-31.06%	-27.63%	-13.75%	-23.57%	-25.17%	-25.17%
	EDMS APU	-14.27%	-13.13%	-12.86%	-12.48%	-12.32%	-12.32%
	Total	-30.80%	-27.58%	-13.73%	-23.19%	-23.32%	-23.32%
SJC	EDMS Aircraft	5.33%	7.23%	9.25%	9.27%	9.68%	9.68%
	EDMS APU	7.29%	7.86%	7.84%	7.77%	7.86%	7.86%
	Total	5.40%	7.25%	9.18%	9.17%	9.16%	9.16%

Table S-12. Greenhouse Gas Emissions for Scenario B (Case 9).

			OAK	SFO	SJC
2035	CO2 (kg)	Aircraft	816,033,501	1,971,028,010	491,314,345
		APU	11,196,914	19,090,638	8,098,780
		Total	827,230,415	1,990,118,648	499,413,125
2035	CO2e (kg)	Aircraft	824,647,823	1,994,780,632	496,425,013
		APU	11,282,110	19,235,897	8,160,403
		Total	835,929,933	2,014,016,529	504,585,416

Table S-13. Change in CO2e Emissions, Scenario B (Case 9) versus 2035 Baseline.

CO2e, 2035	OAK	SFO	SJC
Aircraft	11.29%	-14.94%	20.35%
APU	11.39%	-12.48%	17.46%
Total	11.29%	-14.92%	20.30%

Table S-14 and S-15 show that with diversion of air traffic to high speed rail that criteria pollutant emissions decrease the most at SJC ranging from an 8-11% decrease, while SFO shows the least decrease ranging from 1 to 4% decrease. This is consistent with the estimate that more SJC passengers will be diverted to HSR than SFO passengers. The largest pollutant emission decreases are seen at SJC for both NOx and particulate matter at about 11%. GHG emissions (Table S-16) also show a similar pattern of decrease in emissions of about 11% at SJC, 6% at OAK and 3% SFO.

Table S-14. Reduction in Criteria Pollutant Emissions from HSR Diversion for Scenario B (Case 9)

Criteria Pollutants, 2035		CO (kg)	VOC (kg)	NOx (kg)	SOx (kg)	PM-10 (kg)	PM-2.5 (kg)
OAK	EDMS Aircraft	66,499	9,880	98,849	8,711	1,665	1,659
SFO	EDMS Aircraft	116,547	15,474	112,490	12,165	2,241	2,234
SJC	EDMS Aircraft	69,003	10,257	101,033	8,898	1,809	1,809

Table S-15. Change in Criteria Pollutant Emissions from HSR Diversion for Scenario B (Case 9)

Criteria Pollutants, 2035		CO	VOC	NOx	SOx	PM-10	PM-2.5
OAK	EDMS Aircraft	-3.36%	-4.59%	-6.35%	-6.45%	-6.88%	-6.86%
SFO	EDMS Aircraft	-2.89%	-1.21%	-3.04%	-3.61%	-3.22%	-3.21%
SJC	EDMS Aircraft	-8.10%	-8.73%	-11.12%	-10.87%	-11.42%	-11.42%

Table S-16. Reduction in Greenhouse Gas Emissions and Percent Reduction from HSR Diversion for Scenario B (Case 9).

	Action	OAK	SFO	SJC
CO2 (kg)	Aircraft	51,192,367	63,348,640	52,724,920
	Percent Reduction	-6.38%	-3.46%	-10.82%
CO2e (kg)	Aircraft	52,615,976	68,987,650	53,714,618
	Percent Reduction	-6.38%	-3.46%	-10.82%

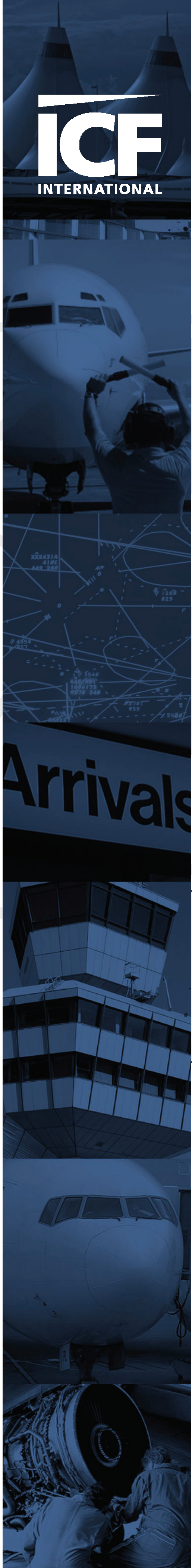
Table S-17 shows that the increase in emissions from diversion of aircraft from the primary airport to the Sonoma County Airport. These increases are a small fraction (< 3%) of the total emissions from any of the three primary airports. Including the GHG emissions in the total for Bay Area airport emissions under Scenario B (Table S-18) still shows that the total GHG emissions for the Bay Area Airports is less than the 2035 future baseline GHG emissions.

TABLE S-17. CRITERIA POLLUTANT EMISSION INCREASES FOR SCENARIO B (CASE 9) FOR OPERATIONS DIVERTED TO SONOMA COUNTY AIRPORT (STS)

			Criteria Air Pollutants					
			CO (kg)	VOC (kg)	NOx (kg)	SOx (kg)	PM-10 (kg)	PM-2.5 (kg)
2035	STS	EDMS Aircraft	18,579	1,382	7,337	1,443	135	135
		EDMS APU	4,342	286	1,146	241	350	350
		Total	22,921	1,668	8,483	1,684	485	485

TABLE S-18. GREENHOUSE GAS EMISSION INCREASES FOR SCENARIO B (CASE 9) FOR OPERATIONS DIVERTED TO SONOMA COUNTY AIRPORT (STS)

			STS				STS
2035	CO2 (kg)	Aircraft	8,595,103	2035	CO2e (kg)	Aircraft	8,681,057
		APU	350,046			APU	352,709
		Total	8,945,149			Total	9,033,766



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Appendix B:
Technical Memo – MTC RASPA Update
Final Noise Analysis Results

TECHNICAL MEMORANDUM

To: Beverly Jones

From: Brad Nicholas

Date: October 15, 2010

Subject: MTC RASPA Update Final Noise Analysis Results

Reference: HMMH Job #303890.000

1. BACKGROUND

Harris Miller Miller and Hanson (HMMH) conducted the airport noise analysis for the Metropolitan Transportation Commission's (MTC) Regional Airport System Planning Analysis (RASPA) update. Our previous Noise Technical Report of July 2010 explained the details of the noise calculation and population impact estimation methodologies, presented the results for 2007, 2035, and six alternative 2035 scenarios, and provided reference information on aircraft noise terminology. This memorandum will present the results of the noise analysis for the final two composite scenarios as well as provide additional information relating to the possible impact of high speed rail on each of the final scenarios.

2. THE ANALYSIS SCENARIOS

The final analysis scenarios included all three major Bay Area airports, Oakland International Airport (OAK), San Francisco International Airport (SFO), and Norman Y. Mineta San José International Airport (SJC) as well as three regional airports, Buchanan Field Airport (CCR), Charles M. Schulz Sonoma County Airport (STS), and Travis Air Force Base (SUU). The two final scenarios are listed and described below:

Scenario A

- Modest traffic redistribution (same as original Redistribution Scenario)
- Modest demand management (same as original Demand Management Scenario)
- No diversion to secondary airports
- Partial new air traffic control (ATC) technology (limited to improved SOIA at SFO, relocated glide slope and RNAV at OAK and FAA Center TRACON automation)

Scenario B

- Major traffic redistribution (beyond original Redistribution scenario)
- Aggressive demand management (to encourage greater traffic redistribution)
- Diversion to Sonoma County Airport (STS) (same degree of STS diversion as in original Internal Regional Airports Scenario)
- Partial new air traffic control (ATC) technology (limited to improved SOIA at SFO, relocated glide slope and RNAV at OAK and FAA Center TRACON automation)

HMMH examined two additional scenarios:

Scenario A with High Speed Rail

Scenario B with High Speed Rail

3. NOISE AND POPULATION IMPACTS RESULTS

Table 1displays the estimated residential population within the 65 dB CNEL contours for each airport and analysis scenario. All previous results are included for reference. Table 2 displays the estimated residential population within the 55 dB CNEL contours. Note that both tables utilize the estimated 2007 population distribution for the 2007 scenario and the estimated 2035 population distribution for all 2035 scenarios. Table 3 and Table 4 display the estimated residential population within the 65 dB and 55 dB CNEL contours using the estimated 2007 population distribution for all calculations.

Scenario A produces lower counts of affected population for all airports. This is expected for OAK, SJC, and STS due to the increased operations at these airports due to more aggressive redistribution in scenario B. The relatively higher affected population for SFO in scenario B is requires explanation due to the fact the there are actually fewer operations at SFO under Scenario B than Scenario A. The primary differences between the aircraft operations in Scenario B and Scenario A which contribute to this counter-intuitive result are:

- Operations are by Boeing 737, Airbus A318/319/320/321, and CRJ-700 aircraft are lower in Scenario B.
- Operations by all international passenger aircraft are higher in Scenario B in the daytime, evening, and nighttime. Though the “increase” in these operations is much smaller than the “decrease” in the aircraft listed above, the noise effect is greater due to the higher noise levels of these aircraft and the fact that operations in the more heavily weighted evening and nighttime period are higher.
- Operations by general aviation aircraft are the same in Scenario A and Scenario B, but are shifted somewhat into the evening and nighttime periods in Scenario B which results in an increase in their noise contribution.

HMMH computed the affected population for the final two scenarios involving high speed rail in the same manner as for all other scenarios. However, due to differences in the methodology of computing the aircraft fleets for these scenarios, it may be appropriate to differentiate the affected population results from the other scenarios. Table 5 translates the differences in population within the various contour intervals between the A and B scenarios with and without high speed rail as show in Table 1 and Table 2 into percentage reductions. The Scenario A / Scenario B “Composite” columns reflect the average change across scenarios A and B due to the addition of high speed rail.

The presentation of these results could take many forms. Exclusion of the population counts for the Scenarios A and B with High Speed Rail from Table 1 and Table 2 and the inclusion of the detailed percentage difference results for Scenario A and Scenario B from Table 5 would provide the same mathematical information, but serve to emphasize the difference in methodology. Alternatively, the composite results alone could be presented, with or without specific airport details. At the most general level, the following statement could be made: A high level analysis of the possible effects of the addition of high speed rail to the A and B scenarios shows an approximate four to six percent reduction in the total population within the 65 dB and 55 dB CNEL contours at the six airports in this study.

Table 1 Residential Population with the 65 dB CNEL Contour by Airport and Analysis Scenario

Airport	2007 Existing	2035 Baseline	2035 Airport Redistribution	2035 Internal Regional Airports	2035 External Regional Airports	2035 High Speed Rail	2035 New Air Traffic Control Technologies	2035 Demand Management	2035 Scenario A	2035 Scenario B	2035 Scenario A with HSR	2035 Scenario B with HSR
OAK	486	657	731	617	644	593	656	657	728	764	668	703
SFO	20,196	48,614	46,287	47,934	48,323	47,073	47,644	48,033	44,893	45,101	43,776	43,776
SJC	1,749	5,644	7,385	5,601	4,927	3,571	5,644	5,644	7,385	9,082	5,234	6,881
CCR	20	33	33	76	33	33	33	33	33	33	33	33
STS	143	224	224	236	224	224	224	224	224	236	224	236
SUU	786	1,008	1,008	1,010	1,008	1,008	1,008	1,008	1,008	1,008	1,008	1,008
Total	**23,380**	**56,180**	**55,668**	**55,474**	**55,159**	**52,502**	**55,209**	**55,599**	**54,271**	**56,224**	**50,943**	**52,637**

Note: The 2007 scenario uses the estimated 2007 population distribution. All 2035 scenarios use the estimated 2035 population distribution.

Table 2 Residential Population with the 55 dB CNEL Contour by Airport and Analysis Scenario

Airport	2007 Existing	2035 Baseline	2035 Airport Redistribution	2035 Internal Regional Airports	2035 External Regional Airports	2035 High Speed Rail	2035 New Air Traffic Control Technologies	2035 Demand Management	2035 Scenario A	2035 Scenario B	2035 Scenario A with HSR	2035 Scenario B with HSR
OAK	35,003	48,139	52,541	45,708	47,302	44,464	48,014	48,139	52,414	54,443	48,749	50,884
SFO	127,289	193,235	187,614	191,513	192,467	189,427	190,804	191,744	184,790	185,172	182,776	182,776
SJC	53,947	145,195	152,530	144,990	141,074	130,899	145,195	145,195	152,530	159,285	142,943	150,534
CCR	2,811	3,906	3,906	6,493	3,906	3,906	3,906	3,906	3,906	3,906	3,906	3,906
STS	694	1,049	1,049	1,100	1,049	1,049	1,049	1,049	1,049	1,100	1,049	1,100
SUU	8,852	10,714	10,714	10,726	10,714	10,714	10,714	10,714	10,714	10,714	10,714	10,714
Total	**228,596**	**402,238**	**408,354**	**400,530**	**396,512**	**380,459**	**399,682**	**400,747**	**405,403**	**414,620**	**390,137**	**399,914**

Note: The 2007 scenario uses the estimated 2007 population distribution. All 2035 scenarios use the estimated 2035 population distribution.

Table 3 Residential Population with the 65 dB CNEL Contour by Airport and Analysis Scenario -2007 Population

Airport	2007 Existing	2035 Baseline	2035 Airport Redistribution	2035 Internal Regional Airports	2035 External Regional Airports	2035 High Speed Rail	2035 New Air Traffic Control Technologies	2035 Demand Management	2035 Scenario A	2035 Scenario B	2035 Scenario A with HSR	2035 Scenario B with HSR
OAK	486	617	686	578	605	557	615	617	684	717	628	660
SFO	20,196	40,385	38,408	39,807	40,132	39,077	39,567	39,887	37,221	37,395	36,262	36,262
SJC	1,749	3,019	3,880	3,001	2,668	2,003	3,019	3,019	3,880	4,715	2,812	3,632
CCR	20	28	28	62	28	28	28	28	28	28	28	28
STS	143	214	214	225	214	214	214	214	214	225	214	225
SUU	786	786	786	788	786	786	786	786	786	786	786	786
Total	**23,380**	**45,049**	**44,002**	**44,461**	**44,433**	**42,665**	**44,229**	**44,551**	**42,813**	**43,866**	**40,730**	**41,593**

Note: All scenarios use the estimated 2007 population distribution.

Table 4 Residential Population with the 55 dB CNEL Contour by Airport and Analysis Scenario - 2007 Population

Airport	2007 Existing	2035 Baseline	2035 Airport Redistribution	2035 Internal Regional Airports	2035 External Regional Airports	2035 High Speed Rail	2035 New Air Traffic Control Technologies	2035 Demand Management	2035 Scenario A	2035 Scenario B	2035 Scenario A with HSR	2035 Scenario B with HSR
OAK	35,003	41,823	45,555	39,729	41,109	38,636	41,723	41,823	45,445	47,157	42,341	44,157
SFO	127,289	160,329	155,672	158,923	159,718	157,188	158,351	159,120	153,266	153,583	151,513	151,513
SJC	53,947	61,422	65,003	61,328	59,648	55,579	61,422	61,422	65,003	68,940	60,437	63,912
CCR	2,811	3,393	3,393	5,679	3,393	3,393	3,393	3,393	3,393	3,393	3,393	3,393
STS	694	931	931	970	931	931	931	931	931	970	931	970
SUU	8,852	8,852	8,852	8,862	8,852	8,852	8,852	8,852	8,852	8,852	8,852	8,852
Total	**228,596**	**276,750**	**279,406**	**275,491**	**273,651**	**264,579**	**274,672**	**275,541**	**276,890**	**282,895**	**267,467**	**272,797**

Note: All scenarios use the estimated 2007 population distribution.

Table 5 Percentage Reduction in Population within Noise Contours with the Addition of High Speed Rail

Airport	65 dB CNEL Contours			55 dB CNEL Contours		
	Scenario A	Scenario B	Scenario A / Scenario B "Composite"	Scenario A	Scenario B	Scenario A / Scenario B "Composite"
OAK	8%	8%	8%	7%	7%	7%
SFO	2%	3%	3%	1%	1%	1%
SJC	29%	24%	26%	6%	5%	6%
OAK, SFO, and SJC	6%	7%	6%	4%	4%	4%
All Airports	6%	6%	6%	4%	4%	4%